The Electrical Review

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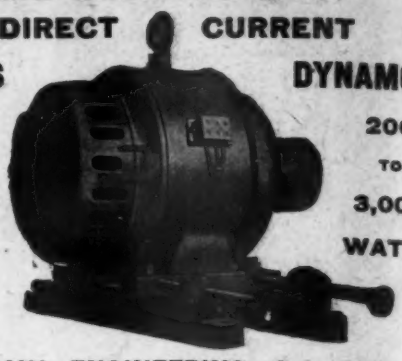

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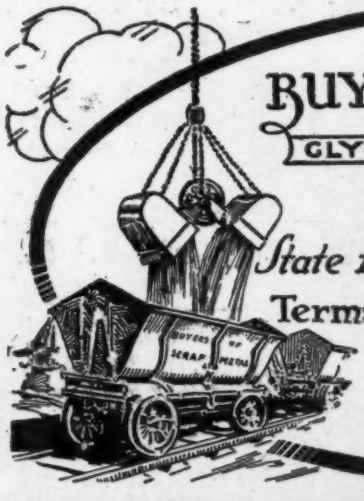

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ELECTRICAL REVIEW.

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QUARTER-WAVE AND HALF-WAVE TRANSMISSION LINES.

EXTRA-LONG-DISTANCE transmission of electrical energy is not a matter of primary importance to the British electrical engineer in his own country, but it is a matter of the utmost importance to him in relation to his interests in colonial and foreign electricity undertakings. In every country there is increased interest in hydro-electric projects—the stimulus, which is likely to be a permanent one, being the shortage and high price of fuel—and there are likely to be important hydro-electric developments in all countries possessing surplus water power directly the markets of labour and materials are sufficiently stable to justify firm estimates. The economic possibilities of water power are determined largely by the availability of a market for electrical energy within the radius of economical transmission. Increase in the distance to which electrical energy can be transmitted economically increases the water-horse-power which can be utilised by making it profitable to develop falls hitherto too remote from industrial centres.

With the materials, equipment, and experience in design and operation hitherto at our disposal, we have been able to transmit electrical energy at pressures between 100,000 and 150,000 volts for distances up to 200 miles or so. Transmission at 200,000 volts and for distances up to 300 miles represents about the limits which can be entertained in polyphase transmission systems such as those in service at present. These limits are, moreover, in the nature of physical limits which cannot be surmounted by mere extension of present-day transmission practice. The line voltage is limited to a pressure in the neighbourhood of 150,000 to 200,000 volts by the appearance of corona discharge, and the distance is limited to, say, 300 miles by the impedance of lines of such section and such arrangement as can be afforded on economic grounds.

If, whilst retaining the same pressure limits, the economic distance of transmission can be increased four-fold, this is an achievement of importance to every electrical engineer, for whatever extends the distribution of cheap electrical energy is of benefit to the whole of the electrical industry. If, in addition, a corresponding economy can be realised in comparatively short-distance transmission lines, the matter is of importance to British engineers, not merely in its relation to foreign and colonial power schemes, but also in its possibilities for this country.

Broadly speaking, the quarter-wave and half-wave transmission systems, discussed so fully in an article which is concluded in this issue, utilise a line which is in resonance, and thus reduce the transmission losses to those due to ohmic resistance alone. The phrases "quarter-wave" and "half-wave" in this connection are very appropriate, a "quarter-wave" line being one in which an alternating current is transmitted from end to end in one-quarter of the periodic time of the current concerned. Similarly, a half-wave line is one in which the time of transmission is one-half of the periodic time.

A quarter-wave line necessitates constant-current input, if constant-voltage supply is to be maintained at the load, and constant-current alternators and transformers are not at present available for large outputs. There is no reason to

doubt that they could be developed, but the necessity for perfecting a new class of station equipment is obviously a serious handicap to a transmission system which represents in itself a radically new application. Fortunately, the half-wave line requires only standard constant-voltage station equipment, and there is no reason why its possibilities should not be determined practically at relatively small expense by interconnection of existing transmission lines.

Without going into details which are presented so fully in M. P. Bunet's article, it may be said that the "natural" length of the half-wave line is from 1,500 to 1,900 miles for 50-cycle operation (i.e., twice that of the quarter-wave line), and that the half-wave system operates at constant-voltage at each end and at constant-current at the centre. Supply cannot be taken from a quarter-wave line at any intermediate point in its length, but transformers, the secondaries of which serve constant-current circuits, can be connected in series at or near the centre of a half-wave line. There is a point of maximum pressure in a half-wave line about one-quarter of its length away from the load, and the voltage is there equal to the station voltage required in ordinary constant-pressure transmission to deliver (over this quarter distance) the same voltage at the load as is actually delivered by the half-wave line. In other words, for a given maximum voltage in the system and a given voltage at the load, the half-wave line delivers energy over four times the distance possible by ordinary transmission, and with a station voltage greater than the load voltage only by the amount corresponding to the ohmic drop. The station voltage in the half-wave system is materially lower than the maximum voltage along the line. Adhering, however, to the same maximum line voltage as is dictated by present-day practice in the matter of insulation, we have the practicable range of transmission quadrupled.

The question now arises: do we need such distances of transmission? Is there any demand for "through" transmission over such distances as those between Niagara and New Orleans, Zambesi Falls and the Cape, or Montenegro and Petrograd, with at the most a tapping near the centre point? Probably not, but whereas a half-wave line which has half-wave characteristics by virtue of its own length and spacing in accordance with usual practice, is necessarily very long, it is possible to "load" a much shorter line so as to give it half-wave characteristics. This may be done by increasing the reactance and/or the capacity of the line. Up to about 10,000 KW., it is sufficient to connect reactance coils in the circuit, but for higher power it is necessary to obtain the desired product of reactance and capacity by using a relatively smaller reactance, and a relatively larger capacity. Up to 50,000 KW. or so, it is sufficient to increase the capacity by using split conductors, which opens up the possibility of operating two or more transmission lines as a single half-wave system. For yet higher power, condensers would have to be used to produce the requisite line characteristics, and this could apparently be done at a capital cost quite reasonable in comparison with the results obtained. At higher frequencies, the natural length of a half-wave line is, of course, reduced in inverse proportion, but 50-cycle supply is the most generally useful, and the best means of applying the half-wave principle to ordinary distances of transmission certainly appears to be by loading the line. The loading need not, however, be entirely artificial. By combining overhead and underground transmission, the resultant inductance of the line may be reduced and the capacity increased, compared with purely overhead transmission, and the underground sections of the line may be located in densely populated areas where overhead lines are undesirable.

These are points which must be decided for each case on its own merits. The basic fact of importance is that half-wave transmission makes possible—by the use of standard alternators, transformers, and line material—efficient transmission of electrical energy over distances of 300 miles or more with the following principal advantages:—(1) Lower weight of conductors per kilowatt per mile than is required for ordinary transmission systems. (2) Much better pressure regulation than is possible in ordinary transmission systems, the station voltage in the half-wave system being practically independent of the power factor of the load and varying with load to about one-quarter the extent of the variation occurring in an ordinary transmission system. Half-wave transmission makes possible transmission over a distance of 1,500 miles with better regulation than is possible in ordinary transmission over one-fifth of this distance and, by loading the system, corresponding advantages can be obtained in shorter transmission lines down to 300 miles or so. For still shorter distances ordinary transmission is sufficient.

Science at Oxford.

An earnest appeal for funds for the erection and endowment of adequate buildings and equipment for the School of Chemistry at Oxford has been issued by Prof. W. H. Perkin, Prof. F. Soddy, and Prof. Benjamin Moore. At present the accommodation available for the hundreds of students who are, and seek to be, in attendance, is utterly and lamentably insufficient—in fact, it can hardly be said to exist. That such a state of things should obtain at Oxford is deplorable in the highest degree, and we hope that the sum required, amounting to about half a million sterling, will be forthcoming.

Oxford is the nursery of the Civil Service, whose utter ignorance of science and scientific methods of thought has been in the past, and will long continue to be, a blighting influence upon the progress of this country and of the Empire itself. The modern Universities are free from this reproach, but they are not the favoured source of civil servants, and until Oxford is reformed and modernised by the development of her scientific side, we cannot hope for much improvement. Let us, then, by all means help Oxford to do this.

L.C.C. Statistics and a Moral.

Opening the L.C.C. Electricity Returns for 1917-8 recently published, we come across first a couple of maps, of the County of London and of Greater London respectively, showing in contrasted colours the areas supplied by local authorities and those supplied by companies. This reminds us of what has hitherto been one of the insoluble elements in London electricity problems, namely, the fact that municipalities and companies jostle each other, elbow to elbow, in a most mad and mixed medley throughout the whole area. Further, their relations have often been in the past best designated as of the "cat and dog" type. But it is to be hoped that in future wiser counsels will prevail, and this wholly unnecessary antagonism will disappear. One point which should tend in the direction of mutual conciliation is the fact that the sides are so equal, that "honours are divided." The present L.C.C. statistics are interesting as indicating such "balance of power." For instance, taking the County of London itself, and measuring the undertakings by the units generated, the companies show 328 million units, and the local authorities 238 millions, a balance in the companies' favour; but taking extra-London, the case is reversed, and local authorities are atop with 134 million units, as against the companies' 78; and taking both together, that is, the whole area of Greater London, there is not much to choose between the 372 millions of the local authorities and the 406 millions of the companies.

Numerically, too, the undertakings respectively are, in total, very near together, being, for Greater London, 39 local authorities and 33 companies. When we come to extent of area, we still find no great discrepancy, so far as the County of London is concerned, the local authorities' area being 55½ sq. miles and the companies' area 64½ sq. miles. When we look at extra-London, however, we notice a big divergence, the companies' area being over 450 sq. miles, as against the local authorities' 167 sq. miles, implying, of course, that the companies have big undeveloped areas. Altogether, therefore, things lie at present very evenly between the two, and it is to be hoped that such an atmosphere of harmony will prevail in the present scheme-formulating period as will exclude altogether any of the old-time differences, which are, after all, entirely political and in no way technical or electrical.

We would point out, in conclusion, that it should be borne in mind, when making a comparison of the working

of municipal and company undertakings, and more particularly when comparing the working costs per unit, that inasmuch as the municipal accounts are made up to March 31st and the corresponding company accounts to December 31st, the comparison, especially for the year 1919, during which there was a considerable rise in the price of coal and in wages, should make allowance for the fact that whereas the local authorities' accounts only include three months of this rise, the companies' accounts include the whole 12 months.

The Engineering Training Organisation.

A meeting of the Council was held on Wednesday last at the Institution of Civil Engineers, to receive the first report of the Executive, and to discuss the future of the movement in the light of the fact that, for financial reasons, it does not appear to be possible to carry it on as an independent organisation. The E.T.O. was founded on October 25th, 1917, and the whole of the work to date has been done by voluntary effort, the initial fund of nearly £1,200, which was subscribed by the leading Engineering Institutions and certain colleges and firms, having been expended on printing, postage, &c.

The report is a volume of 330 pages, and incorporates a register of the available facilities for engineering training at the various engineering works and colleges throughout the country, but, unfortunately, the funds at command were not sufficient to permit of more copies being printed than would suffice for the members of Council.

The Executive, finding the expenditure too heavy to be borne by the Engineering Institutions and Associations, invited 246 engineering firms to become members at a minimum subscription of 10 guineas per annum, but only 30 firms consented, and therefore it is feared that the organisation will lapse.

This unexpected and unhappy conclusion will be deplored by all who are interested in this most important subject. Those who were present at the inaugural meeting will remember the enthusiastic support which was then accorded to the movement, and which certainly justified the promoters in devoting their unselfish efforts to the evolution of a comprehensive scheme on a permanent foundation. The originators of the movement—Messrs. A. E. Berriman and A. P. M. Fleming—deserved the hearty thanks of the engineering industries for the valuable work they had already accomplished during the several years preceding the meeting, and since then they have not relaxed their efforts; Mr. Berriman has acted as honorary organiser, in which capacity he must have shouldered a heavy burden.

The scheme was directed to the provision of adequate training not only for the engineer, but also for the rank and file of the industry, and was intended to remove a great defect in our educational system by providing a ladder which would enable promising youths to climb "from the bench to the university," and thus make available for the benefit of the whole nation, the potential talent and intellectual ability of which an inexhaustible store exists in every class of society. Other objects of the organisation were to increase the efficiency of engineering training, and to provide a central information bureau.

Eighteen months ago the Executive advertised for an "engineer secretary," a first-class man with a good salary, and an appeal was made to engineering firms to provide the necessary funds (Electrical Review, February 7th, 1919); but the response was evidently very disappointing, and the appointment was not made. It is exceedingly regrettable that the necessary support was not forthcoming; if but 200 firms had contributed the trifling amount asked of them, in addition to the contributions of the engineering institutions, the organisation could have been established on a satisfactory basis and enabled to produce results which, we have no doubt, would have commanded the confidence of the industry in the future conduct of the scheme.

Without for a moment reflecting on the efficiency of the organisers, whose capacity for work must have been taxed to the utmost, we venture to suggest that the true cause of the indifference manifested by the industry to the claims of the Organisation is to be found in the lack of publicity. We remarked in February last year, when commending the movement to our readers, that it had not been much in evidence—and that is the whole thing in a nut-shell. The whole of the engineering Press, we believe, cordially supported the scheme, and would gladly have kept it before the public, but the promoters, doubtless overburdened with work, were not able to supply the information required for that purpose, while the Press was not aware that it was in difficulties. *Hinc illæ lachrymæ.*

As we go to press, we learn that the Council proposes to hand over the work to the Federation of British Industries (see our "Notes" columns).

A Tax on Turnover.

A representative of the *Financier* recently had an interview with Mr. B. H. Morgan, F.R.S.S., M.I.A.E., who advocates a tax on turnover, instead of the destructive and unfair device known as the Excess Profits Duty. Mr. Morgan lays stress on the fact that the Excess Profits Duty is a positive bar to enterprise, its incidence being uncertain and often grossly unfair.

Why should a standard of profits earned by established firms six years ago be made the basis for taxation to-day? This crude device was bad enough during the war, but to-day, when reconstruction of industry is urgently calling for the starting of new businesses, it seems to be a most extraordinary anomaly that every new business should be handicapped, less or more, from the start, owing to the absence of the pre-war standard of profit enjoyed by established firms in the same line of business.

It is, of course, obvious to everybody that it is a hopeless task to attempt to establish a new firm to-day to compete with firms established before the war, and having a pre-war standard of from 5 to 15 per cent.

Such firms can underquote a new concern every time, and put it out of business very quickly. A tax of 1 per cent. on the turnover, however, as proposed by Mr. Morgan, would fall, like rain from heaven, equally upon new and old firms and upon those which were successful or unsuccessful before the war. In the opinion of Mr. Morgan, a tax of only that moderate amount on turnover would produce a much larger amount than the Excess Profits Duty. There would also be the advantage to the Chancellor that, by terminating the Excess Profits Duty, he would save himself from having to pay back considerable sums of excess profits already received by the Treasury as the result of the continuation of the tax. It will be remembered that under the provisions of this strange and ill-considered impost, any firm may average its profits throughout the whole period of the duration of the tax, and, if it should now be incurring losses, can demand back excess profits already paid and taken fully into credit in previous Budgets. There is a growing impression that Mr. Austin Chamberlain's obduracy will not result in bringing in the revenue expected, but, on the contrary, will subject him to a very serious disappointment.

The Excess Profits Duty is just one of those things that anyone with a scientific turn of mind can hardly find the patience to discuss. It could hardly have been invented by any other combination than that of a Labour man and a lawyer. Certainly no engineer, electrical or otherwise, could have had anything to do with it. Our own view is that anything that would remove the gross injustice of taxing the small men and the new firms more heavily than the big men and the old-established firms, would be welcome. Apart from that, however, any simplification such as that suggested by Mr. Morgan, which would enable the taxes to be collected with less difficulty and expense, would be really a permanent economy. The present complex of taxes, duties, and stamp fees, combined with the present habit of the Government of using the trading institutions of the country, such as the Post Office and the railways, for the purpose of imposing special taxes on persons using those services, should be swept clean away and a new start made with some simple form of taxation, which could be understood by a plain man, and collected at one-quarter the cost; from this point of view, Mr. Morgan's suggestions are worthy of careful attention.

THE BRITISH ASSOCIATION.—II.

Early in the morning of Tuesday, August 24th, the organising and sectional committees got to work, and soon the reading of papers was commenced in the various buildings allotted to the sections. In Section A (Mathematical and Physical Science) Mr. J. Evershed, F.R.S., read his paper on "Measures of the shifts of the Fraunhofer lines and their interpretation, particularly with relation to the Einstein theory." In Section B (Chemistry) a paper on "Industrial Alcoholism," by Capt. A. Desborough, was read and discussed. "A Criticism of the Majority Report of the Royal Commission on Decimal Coinage," by Mr. H. Allcock, was the first paper read in Section F (Economic Science and Statistics). Three papers were read and discussed in Section G (Engineering): "Testing materials at high temperatures," by Prof. F. C. Lea; "Experiments on impact torsion," by Mr. Eric Jones; and "The cutting edges of tools," by Col. R. E. Crompton, C.B. The report of the Committee upon Training in Citizenship was presented in Section L (Education). Several excursions were arranged for the afternoon, including visits to Cardiff Docks, Grangetown Gas Works, and the Power Station. About 20 members secured tickets for the last named, but, owing perhaps to the lack of transport during the municipal strike, only eight were present; the electricity works is at the tramway terminus, and under normal conditions easily accessible. The visitors found a very small volunteer staff "carrying on," but half the plant was shut down, partly on account of the lack of men and partly because the traction side which occupies a large part of the station was not needed. Much interest was evinced in the Siemens and Westinghouse 2,000-kw. turbo-alternator sets and the large English Electric d.c. generators for supplying the tramways. The visitors then crossed over to the tramcar repair shop, where the item which attracted most attention was the arc-welding plant, which was being used for the repair of gear cases.

Many eminent men were on the platform at the inaugural general meeting in the Park Hall at 8 p.m., including the Lord Mayor of Cardiff, the Marquis of Bute, Lord Treowen, Lord Pontypridd, Lord Tredegar, H.H. Maharaj Rana of Jhalawar, Sir Oliver Lodge and Bishop Welldon. Sir C. A. Parsons, the retiring President, in a brief speech, introduced Prof. Herdman, giving a short sketch of his life and achievements. Prof. Herdman then read his address, which was briefly noticed in the Electrical Review of August 27th. The Lord Mayor extended a hearty welcome to the Association on behalf of the citizens of Cardiff, and in a witty speech touched upon the importance of the science of oceanography to a city situated as Cardiff is. In seconding a vote of thanks to Prof. Herdman, Sir Oliver Lodge recalled the events of twenty-nine years ago, when they were working together. He remembered that when Prof. Herdman secured a ship from the Government for the purposes of oceanographical research, he (Sir Oliver) was asked to accompany the party, not because Prof. Herdman thought a great deal of him as a biologist, but because he was a strong and healthy young man. Sir Oliver, amid much laughter, said that one of his first tasks as a member of the expedition was the carrying of sacks of coal over the coast of a very rocky island.

It was announced that the number of members attending the annual meeting was 1,370—a very satisfactory total.

On Wednesday, August 25th, the morning was devoted to sectional papers and discussions. In the Mathematical and Physical Science Section, Dr. F. W. Aston read a paper entitled "Mass spectra and the constitution of chemical elements," and Sir E. Rutherford, F.R.S., discoursed upon the building-up of atoms, explaining the electronic theory to his audience by means of diagrams. He discussed the bombardment of the atomic nucleus with alpha particles, explaining that these were repelled at varying distances and thus prevented from reaching the nucleus. He stated that if the nucleus could be reached by these particles, the explosion would very probably disintegrate the atom. The time of the Chemical Section was devoted wholly to the consideration and discussion of papers on lubrication, in which many members took part. Section F (Economics) listened to the reading of papers on "The present supply of coal and its effects on the shipping interests of Cardiff," by Mr. J. O. Cheetham, and on "The conduct of the mining industry," by Mr. R. F. Adgie. Among the papers read before the Engineering Section was one on "High-speed petrol engines," by Mr. H. R. Ricardo; Prof. Watkinson's paper on "Some methods of obtaining ignition in internal-combustion engines with low compression pressures" was cancelled.

At their afternoon meeting the members of the Physiological Section were presented with two papers by Prof. A. D. Waller, F.R.S. The first dealt with the application of electricity to plants and the responses obtained. Prof. Waller demonstrated that the result of passing an inductive shock through a plant was an after-current, the direction of which depended upon the condition of the plant. If the plant was in a state of growth in all parts, the after-current would have the same direction as that of the first current. If one part was physiologically inactive and another active, the after-current would have its direction from the active to the inactive section. The second paper was a consideration of the effects of emotion upon the human body. The apparatus described consisted of a Wheatstone bridge, the fourth arm of which was connected through a potentiometer to two electrodes applied to the subject under test. By means of oscillograms Prof. Waller showed that when the mind was at rest a small current passing through the circuit kept a connected galvanometer in a state of rest. The effect of a threat was shown to be a violent deflection of the galvanometer needle, and the shock given by means of a pin-prick or electricity caused a still greater deflection. Similar tests having the electrodes connected to the subject's foot, leg and forearm were illustrated, the effects varying somewhat. Prof. Waller stated that his theory to account for the deflection of the galvanometer needle was that the various emotions opened the pores of the skin and lessened the body's electrical resistance or increased its conductivity. A pressure of 1/10 volt was generally used for the experiments described. Upon the conclusion of Prof. Waller's papers the members of the Section made a tour of inspection of the new physiological buildings, which are stated to be some of the finest in the United Kingdom. Among the various visits, &c., arranged for the afternoon was the inspection of the *Western Mail* and *South Wales News* printing works. A party of members went to the Castle at the invitation of the Marquis and Marchioness of Bute, and others visited University College, where the Senior Deputy Chancellor (the Rt. Hon. Lord Kenyon) conferred degrees upon a number of British and foreign scientists. At the Park Hall in the evening, Prof. A. W. Kirkaldy, M.Com., delivered a public lecture on "Present Industrial Conditions" to a fairly large audience of the citizens of Cardiff.

On Thursday, August 26th, there was a rather larger number of matters of indirect if not direct electrical interest. In Section B (Chemistry) Prof. C. H. Desch, who recently succeeded Prof. Arnold in the Chair of Metallurgy at Sheffield University, gave an interesting account of the manufacture of tungsten filaments for incandescent electric lamps, of which we give an abstract elsewhere. To the chemists, the paper, together with one by Mr. J. L. F. Vogely on the tungsten industry, proved exceptionally interesting, although they recorded facts known to metallurgists and makers of tungsten wire for electric lamps. Nevertheless, it was suggested that if the trade Press did not publish the papers in full, a report should be made to the Association to do so. These two

papers were followed by an exceedingly valuable one on the prospects of establishing an electrolytic zinc process in this country. This paper we abstract at some length. The zinc industry in this country is in low water at the present time, and three important South Wales works have been shut down during the past few months.

In Section B on Thursday, also, the report of the B.A. Fuel Economy Committee was read and briefly discussed. It is to be regretted that the feud, if we may use the term, between the Committee and the Fuel Research Board still continues. The point is that it was practically out of the propaganda work of the B.A. Committee in 1915 that the Fuel Research Board was formed, with Sir George Beilby as the Director. When the Board was established, the Fuel Economy Committee offered its assistance, but judging by what Prof. Bone said last year and again this, the Fuel Research Board has declined to avail itself of any assistance from this quarter. The case for the existence of the Committee is that it is practically the only body which can be said to be looking after the interests of the consumer, but even as such, the Fuel Research Board ignores it to the extent that no notification is given to the B.A. Committee of any conferences and meetings such as have taken place in connection with the new legislation for the gas industry. Exasperated by this treatment, the B.A. Committee went to the Board of Trade direct, and had reason to believe that something would come of its action. This was at a time when Sir Auckland Geddes was at the Board of Trade, but a change in the political head of that department seems to have been disastrous for the objects which the B.A. Committee had in mind, viz., a limitation of the impurities which gas undertakings may put into gas under the new legislation. This was the burden of the story which Prof. Bone, as chairman of the Committee, had to tell the Section, a story which he repeated in the afternoon at the joint meeting of the South Wales Institute of Engineers and the B.A. Fuel Economy Committee, when two papers dealing with coal were discussed.

In Section G, Prof. J. T. MacGregor-Morris described a portable direct reading anemometer for measuring ventilation in coal mines, which has been taken up by several people, especially in the North of England. This was followed by a paper, by Mr. H. T. Tizard, on "Specific Heat and Dissociation in Internal-combustion Engines," which reminds us that no report from the B.A. Gaseous Explosion Committee was presented this year. The work of this Committee has been interrupted by the war and the lamentable death of Prof. Bertram Hopkinson. Thus there has been little advance in recent years in the thermo-dynamical theory of internal-combustion engines. On the other hand, there have been great practical advances, and it is said that the actual efficiency of a modern high-speed engine is higher than the theoretical efficiency calculated on the old specific heat figures of Clerk and Langer, even if no allowance is made for the loss of heat; the paper dealt with this aspect of the matter.

Another paper in Section G was by Prof. A. L. Mellanby and Mr. W. Kerr, dealing with steam action in simple nozzles. This was a short study of the variants in nozzle expansion.

Friday saw the close of the Sectional meetings. Several of them were busy until a late hour in the afternoon, whilst the more fortunate members of those Sections which had concluded their labours were able to enjoy various excursions. The weather remained fine—indeed it improved as the week progressed, and in this respect, at least, the B.A. maintained its reputation. During the last 12 years we hardly remember an occasion when the British Association has had wet weather. The inconvenience caused by a week's accumulation of dirt and litter in the streets through the strike of municipal employés was not abated, for although the strikers were reported on Thursday to have settled their differences, they were still having acrimonious discussions among themselves as to whether they should or should not go back. Even the gravediggers joined the malcontents, and thus, as a speaker in one Section facetiously put it, there was no inducement even to die in Cardiff. The meetings of the strikers, indeed, afforded an interesting opportunity of studying psychology in a practical form, after listening to a whole series of papers on industrial psychology written more or less from what might be termed the theoretical aspect. Outside the City Hall, the men's organisers, after having successfully induced them to strike, were that morning finding it an exceedingly difficult task to induce them to return to work. "You go back to work," cried the organiser, wagging a finger of authority at a crowd of some hundreds. "That's the second time you've told us that, and we ain't gone back," cried one man. However, the men went back, and by the time we left on Saturday morning the streets were being rapidly cleaned and the tramcars were running normally.

Another aspect of the psychological problems which have been discussed appealed to us. Quite a large body of men are now taking up the study of industrial psychology, and are making a brave effort to put it upon a common-sense and practical level. They lay down laws which should be applied to workers to keep them in good health and spirits, and they prescribe that not more than so many hours' work a day should be done if the best results are to be obtained. These same men who are striving to make the path of the average worker easier are themselves, to all outward appearances, working double time. If they are not careful they will bring about, in themselves, the very conditions of reduced output which they are striving to prevent in the case of the general worker. We shall have to start a study of the psychology of the psychologist to save him from himself.

Section G on Friday morning was concerned with only one electrical paper, viz., that of Prof. G. W. O. Howe, the Recorder of the Section, who gave a most interesting lecture on the efficiency of transmitting aerials and the power required for long-distance radio-telegraphy.

The Psychological Sub-section of Section I (Physiology) has been one of the most active of all the Sections, and its aspiration to become a full Section next year seems more than likely to be fulfilled. This active young Sub-section, presided over by Dr. C. S. Myers, F.R.S., met morning and afternoon all through the week, and on Friday it devoted the whole of its energies to a consideration of industrial psychology. There is a great deal more in this than many people, even industrialists, imagine, and we are pleased to note that those who have taken up the problem in this country are striving to get away from the effect of the American ideas on industrial management—so-called—so far as these have tended to turn the worker into a machine. Particularly interesting was a paper by Prof. E. L. Collis on the psychology of industrial convalescence, which raised an important question concerning the present regulations applying to national health insurance and sick club benefits in illness. The argument put forward is that the system by which all benefit ceases the moment a man recovering from an illness does even half an hour's work per day is wrong in principle, and that a man should be nursed back to the full enjoyment of his physical and mental faculties by a gradually increasing amount of employment, the amount of sick pay varying proportionately. Problems of vocational selection, and the aims and work of a National Institute of Applied Psychology, were the subjects of other papers dealt with by this Sub-section.

Late on Friday afternoon in Section K (Botany), Sir J. C. Bose, F.R.S., had an overcrowded meeting to witness a demonstration of the growth of plants by means of the magnetic crescograph, and in Section L (Education) in the morning, Principal J. C. Maxwell Garnett dealt with higher technical schools in a national system of education. In this paper diagrams were exhibited to illustrate certain recommendations recently published by the Federal Council of Lancashire and Cheshire Teachers' Associations, the paper being specially concerned with the provision of the highest technological education in a national system of education.

Lubrication and the Germ Process.

By H. M. Wells and J. E. Southcombe, M.Sc.
(*Abstract.*)

Section B.—Chemistry.

The authors drew attention to the fact that the modern view of lubrication on the physico-chemical side was the existence of a residual valency or affinity between the oil and the solid surfaces of the bearing and journal. The problem had, therefore, to be considered as a kind of intimate relationship between the oil and the metal. This was quite a different view to that held by investigators in the past, who thought that the property of "oiliness," so strongly manifested by fatty oils as compared with mineral oils, resided in some particular physical characteristic of the oil itself.

The modern point of view had been elaborated recently by a number of students of the subject. The authors had discovered the "reason" why the fatty or fixed oils possessed friction-reducing properties superior to those of mineral oils. They had shown that this was due essentially to the presence in fatty oils of minute quantities of free fatty acids, which were absent in the majority of mineral oils. In consequence of this discovery they had added small quantities (about one per cent.) of fatty or organic acids, which were easily accessible and relatively cheap, to mineral hydro-carbon oils. The products so obtained possessed remarkably low frictional coefficients. As an example, the addition of 2 per cent. of common fatty acid to a mineral hydro-carbon oil reduced the coefficient of friction shown by this oil on a friction-testing machine from 0.0084 to 0.0052, a diminution of 26 per cent.

By suitably choosing the type of fatty acid to be added to mineral oil the behaviour of oils in the presence of water and other contaminating substances could be modified at will. It was also shown that the risk of metallic corrosion was even less with these oils than with the usual compounded oils, because the latter frequently developed in working notable quantities of free acid.

The principle of making mineral lubricating oils possessing increased frictional-reducing properties by adding to mineral oils suitably chosen fatty acids in relatively minute amounts had been patented throughout the world, and had been somewhat fancifully called the "germ process," because the fatty acid was the germ of the idea.

The value of the process lay in the fact that oils possessing friction-reducing properties much superior to mineral oils could be prepared at relatively little extra cost to mineral oils. Secondly, by this means an immense quantity of fatty oils, suitable for the manufacture of margarine and other foodstuffs, was liberated for the country's needs and replaced by a much smaller amount of commercial fatty acids, which were quite unsuitable for food and were more or less in the nature of by-products.

Finally, it might enable lubricating oil manufacturers to produce the highest class of friction-reducing oils from comparatively thin—therefore cheaper—mineral oils, and incidentally this might have the utmost significance to-day when they were striving to foster and develop the mineral oil production of this country and the Empire.

Electrolytic Zinc.

By Samuel Field, A.R.C.Sc. (Lond.), F.C.S.
(*Abstract.*)

Section B.—Chemistry.

The Zinc Industry.—It is advocated that, in view of the present depression of the British zinc industry and the very limited output of less than 10 per cent. of the pre-war consumption, attention must be given to the application of the results of modern research in order to retain and adequately develop this "key" industry. The current method of distillation is severely handicapped and overburdened by scarcity of home supplies of suitably pure raw materials, by the poor recovery of metal from any but the highest grades of ore and the best types of fuel, by a very low thermal efficiency, by the poor quality of the product, and by high fuel and labour costs.

Advantages of the Electrolytic Process.—During the past few years, however, considerable attention has been given to the possibility of the establishment of an electrolytic zinc industry in Great Britain. As a result of this work, it may be stated, with confidence, that British electrolytic zinc is now an economic proposition. Research work has been carried out at Swansea during the past four years. In the later stages, in a 1½-ton per day plant, over 120 tons of metal have been produced, which commanded an appreciable premium over the ordinary spelter, and demonstrated (1) that the electrolytic product is a certainty from even the complex ores available in the country, and (2) that the process can be carried out with much greater efficiency and less cost than that of distillation.

Outstanding advantages of the method are: (1) The high purity of the product, ranging up to 99.95 per cent. zinc and over; (2) high recovery; (3) the almost entirely mechanical handling from ore to ingot, thus eliminating excessive labour cost; (4) the easy concomitant recovery of accompanying metal values, such as lead and silver, and (5) the availability of large resources of home ores (which, by reason of their complexity, are not amenable to distillation), thus ensuring an established home production of a metal so largely used in the galvanising industry in which Great Britain once occupied the premier position.

Outline of Process.—The process briefly is as follows: Ores or concentrates suitably crushed are calcined, sulphur being recovered as sulphuric acid or other sulphur product. The calcination is designed to meet the special requirements of the later operations, and thus markedly differs from methods followed in the case of distillation. From the calcined product the zinc is extracted with the acid zinc sulphate liquors from the electrolytic cells. The liquor is reduced to low acidity by means of the ore, and then completely neutralised by available waste zinc products or by whiting. An important point in the process is the prevention of gel formation from soluble silica, thus completely surmounting a difficulty still experienced in established electrolytic zinc works. The liquors are separated from the insoluble residue (which contains the lead and silver) and the crude zinc liquor now contains about 10 per cent. of zinc together with small amounts of impurities such as arsenic, antimony, copper, cadmium, iron, nickel, and cobalt. The effect of each of these impurities on the process of zinc deposition has been carefully studied. Each of these impurities, even in very small quantities, had a most detrimental effect in the electrolysis of acid zinc sulphate liquors. One of the chief problems of electrolytic zinc is the reduction of these deleterious impurities down to harmless quantities. New methods of purification have been worked out for each impurity, and methods are available for their removal in two stages or even in a single operation. When present in sufficient amounts, copper and cadmium are recovered as well as eliminated, and provide additional sources of revenue. The purified liquor now contains only exceedingly minute traces of cadmium, with nickel and cobalt each reduced to much less than one part per million of liquor. The pure liquor is now acidified with outflowing solution from the cells, bringing the composition to approximately 8 per cent. zinc and 3 per cent. acid, and electrolysed between lead anodes and aluminium cathodes. In this operation, the average cell P.D. is 3.5 volts, or less with current efficiency of about 90 per cent., giving an energy consumption of 3,200 units per ton of cathode zinc. The zinc content of the electrolyte is brought down to 3 per cent. or less with an increased acidity up to 10 to 11 per cent., and this liquor is used cyclically for the extraction of zinc from the calcined ore, and for acidifying the pure zinc sulphate solution prior to electrolysis. The electrolysis of acidified zinc sulphate solution is attended by insuperable difficulties except when pure liquors are employed, and the preliminary purification process constitutes therefore the most important stage in the cycle of operations. The cathode deposits are allowed to grow for two days with a current density of 25 to 30 amperes per sq. ft. They are sound and compact, and readily detached from the aluminium sheets, and after rinsing are melted down to ingots containing not more than .02 per cent. cadmium, .02 per cent. lead, and .01 per cent. copper and iron. Electrical power consumption in the subsidiary mechanical processes is amply covered by an allowance of 800 KW.-hours per ton, giving an overall consumption of 4,000 KW.-hours per ton of zinc, approximately from one-third to one-half of that required by the electro-thermal method. The residues from the extraction process contain all the lead and silver which are recovered as argentiferous lead by blast furnace smelting. It can only be reasonably anticipated that, in addition to the well-known outlets for the metal, new and still wider fields will open up for a product, the purity of which can easily be guaranteed at 99.95 per cent.

Ductile Tungsten.

By Prof. Cecil H. Desch. (*Abstract.*)

Section B.—Chemistry.

The properties to which the metal tungsten owes its importance, apart from its use in the production of alloy steels, are its high melting point of 3,350 deg. C., and its great ductility and tensile strength when drawn into the form of fine wire. These properties have led to its almost universal adoption for the filaments of incandescent electric lamps. The ductile metal is prepared from the powder, which is pressed into rods and then made compact by heat, the particles being sintered together by the passage of an electric current. Even in this condition it is quite brittle, and ductility is only obtained by swaging at a very high temperature after heating in hydrogen. The swaging is followed by drawing, the metal becoming progressively more ductile until it can be bent or drawn cold. The tensile strength of a wire 0.0011 in. in diameter is nearly 270 tons per sq. in. Tungsten differs from other metals in being more ductile when cold after severe working and deformation than in the annealed condition. The possibility of drawing tungsten cold depends on the grain size of the original sintered ingot, and it is the practice to examine every ingot microscopically, all those ingots which show more than a certain limiting average grain size being rejected. The grains grow on long exposure to high temperatures, as when used in lamp filaments, and in order to prevent this growth from becoming excessive, and so rendering the filaments brittle, a small quantity of thorium oxide is mixed with the tungsten powder in making the original ingot, and the infusible and non-volatile particles of this oxide present an obstacle to the growth of the grains.

THE MACHINE-TOOL AND ENGINEERING EXHIBITION.

A period of eight years has elapsed since a representative collection of machine tools was last brought together in the United Kingdom. During that period many changes have been brought about in the British machine-tool trade, and the lessons of the war have had a wide influence on the industry.

It will be remembered how, soon after the outbreak of war, it was quickly discovered that the main obstacle to the supply of "munitions" was the fact that the machine tools necessary for their rapid production in quantity did not exist. As a consequence, energetic steps were taken to meet the urgent demands of the situation, and great developments were made in the machine-tool trade of this country; many valuable lessons were learned by both makers and users of such tools and machinery.

Repetition work was introduced into hundreds of factories where it had previously been considered impossible, and as these factories have gradually turned over from war work to peaceful trade, the repetition idea has in many instances persisted and continues to be employed on commercial lines. The need for a higher degree of accuracy of workmanship, for greater care in the selection and treatment of materials, has resulted in a development of technique. The tendency to specialisation has increased, and the continually advancing costs of labour have made it imperative to employ machine tools of efficient type on a constantly increasing scale.

These causes, together with the shorter hours now worked, have combined to create such a demand for machine tools as has kept the trade relatively well supplied with orders.

The present exhibition, which is the second organised by the Machine Tool Trades Association, is being inaugurated by a dinner at Olympia, London, W., to-night, and will be opened to the public to-morrow. It will remain open daily until September 25th, and offers a unique opportunity of observing the results that have been attained during the unprecedented period that has elapsed since the last exhibition was held, in October, 1912.

Nearly 200 exhibitors, of whom a number will have on view tools or machinery of an electrical or allied nature, will show over 3,000 tons of exhibits. The whole of the available space has been readily let, and will be fully occupied. In addition to the productions of home manufacturers, collections representative of the latest achievements of America and other machine-tool producing countries will be displayed, but the Association has declined to permit any products of German or Austrian firms to be exhibited.

In the following brief review of the exhibits, attention will be confined to objects of an electrical interest.

Messrs. Greenwood & Batley, Ltd., Leeds, will exhibit amongst other things a "Greenbat" industrial electric truck capable of carrying 2 tons and fitted with a Chloride storage battery. Also a standard ventilated and enclosed 10-h.p. shunt-wound motor running at a speed of 1,000 r.p.m., in addition to a 30-h.p. De Laval

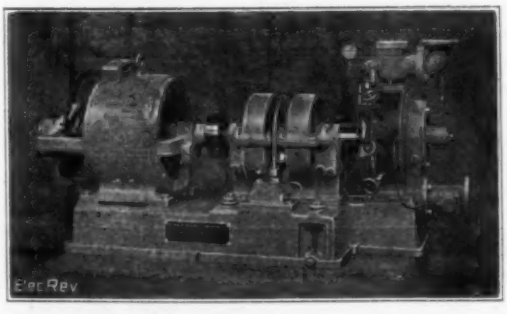


Fig. 1.—De Laval 30-h.p. d.c. Turbo-Generator.

steam turbine, direct coupled to a 20-kw. d.c. generator, as illustrated in fig. 1. This is a standard ship-lighting set as supplied to the Admiralty and most of the shipping lines and cross-channel services. This type of plant is also used to light and drive small mills, &c.; it is made in standard sizes from 5 to 600 b.h.p., and fitted with double helical gearing and forced lubrication.

Messrs. Irwin & Jones, Ltd., London.—This stand will include, amongst other exhibits, "Hunt" electrical industrial trucks. The standard truck for factory, dock, &c., use has a spur-gear double-reduction drive and a capacity of two tons. The three-wheel truck is specially designed for use where space is restricted, and also in conjunction with lifts. It has a "motor-in-wheel" drive and a capacity of 30 cwt. Fig. 2 shows a truck fitted with an electrically-operated self-sustaining jib crane. This D F-60 type of crane has recently been improved in two respects. First, the length of the jib has been increased from 66 to 70 in.; secondly, a chain has been substituted from the winding-drum over the crane post sheaves and over the jib sheave, with a hook and weight in the usual way. On the jib sheave there has been provided a special ratchet gear, which can be locked at any time, and thus allow the chain in winding up to pull up the jib with the load. To keep the jib in a desired position, the anchoring of the jib has been improved by providing a notched quadrant arm, which slides through a guide on the crane post, where a ratchet or detent engages in the notch of the quadrant arm, so that the jib can be fixed at will in one of several positions. The whole of the controls of the crane are worked electrically—that is, there is a

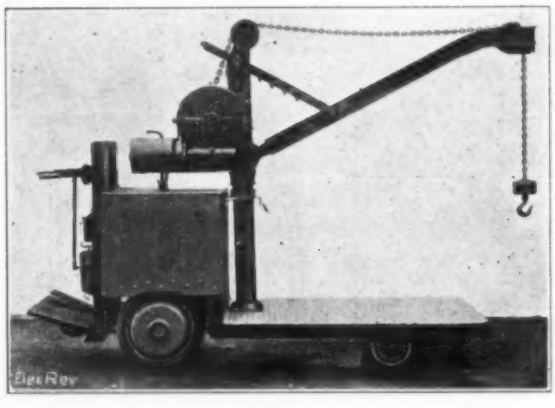


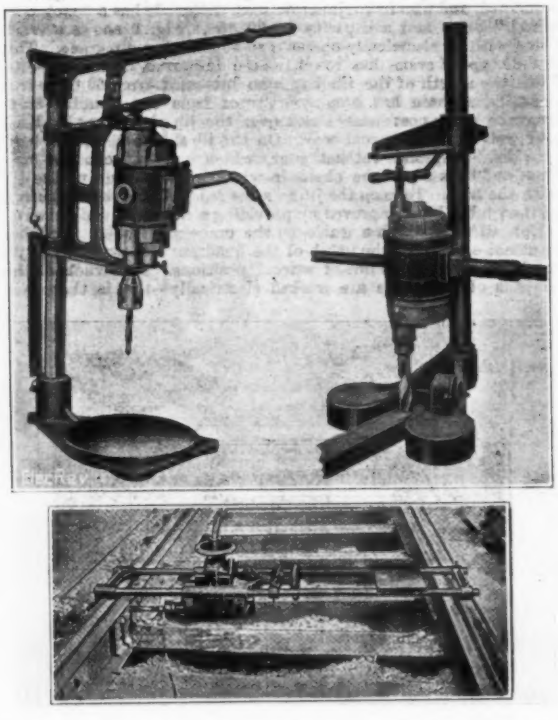
Fig. 2.—Electrically-Operated Truck and Crane.

separate winding motor connected through a worm gear to the winding drum with a reduction of 102 : 1, and as the worm gear is non-reversible, the load is self-sustained. A reversing switch is provided, and the same controller which controls the speed of the truck, controls the starting and stopping of the winding motor; as there is a two-way switch provided, it is impossible to run the truck and the crane at the same time. The truck itself is a two-ton vehicle having a platform space 5 ft. long × 3 ft. 1 in. wide, which platform is only 11 in. from the ground. It is provided with a four-wheel steer, and has an exceptionally small turning radius, 5 ft. 8 in. measured outside the wheels. The truck is propelled by two motors of the coupled-gear type, built into the road wheels, fitted with bevel reduction gear, and although entirely built into the wheel, they are get-at-able by taking out four bolts of the steel cover, which then exhibits the motor and the bevel gear for examination. The crane can also be fitted to one of the firm's standard A-type trucks. The truck is fitted with 12 "I M V 8" ironclad Exide cells.

The Igranic Electric Co., Ltd., London, will have on view a variety of types of control gear both on its own stand and on the stands of other exhibitors where it will be applied to machine tools in operation. The exhibits will include manually-operated and automatic motor-starting rheostats, amongst which special mention may be made of the "counter-E M.F." starter that is suitable for motors up to 2 h.p. and in which the speed of cutting out the starting resistance is automatically governed by the load conditions. Automatic starting and speed-regulating panels (time element control), battery-charging panels, and a mill type contactor panel will be on view in addition to a.c. control gear. In connection with the latter it should be noted that the three-pole "across-the-line" starter for polyphase squirrel-cage induction machines has both fuse and low-voltage protection in the running position. Also the a.c. "conspede" control panel for slip-ring motors shows the patent split housing. One handle controls both the stator and the rotor circuits, and the device is consequently very simple to handle; magnetic contactor switches open and close the main circuit. Electric "Leesona" coils, master switches, different types of push-buttons and other accessories will complete the exhibit.

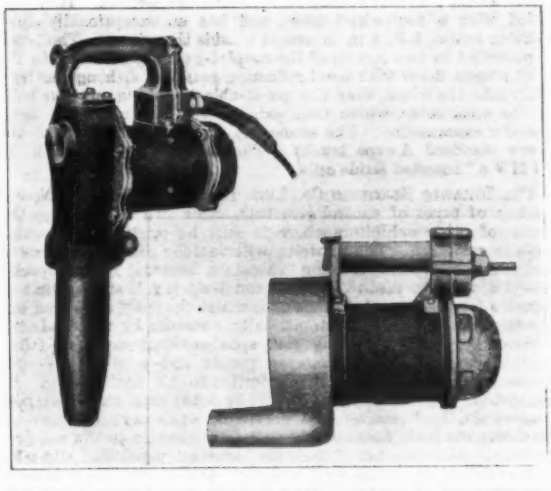
The Consolidated Pneumatic Tool Co., Ltd., London, will show a series of pneumatic and electric tools; the latter will include a.c. and d.c. drills, hammers, portable blowers, grinders, polishers, &c. Fig. 3 illustrates a sensitive drilling stand, and fig. 4 a magnetic drill post for various sizes of drills. The 600-volt d.c. rail drill, shown in fig. 5, is a very useful tool. The frame does not need bolting down, but is simply hooked over the rail to be drilled, the operator holding down the other end of the frame by sitting on the seat shown, which places him in a convenient position to operate the feed. The side spindle of the drill permits drilling close to the ties without the use of an angle attachment, and the vertical adjusting screw, with guides for the

drill, affords ready means for locating the holes vertically on ordinary tee or girder rails. Fig. 6 shows a hammer drill equipped with a universal motor, which will operate on either A.C. or D.C. It is designed for drilling stone or concrete where a hammer blow is necessary; the blow is delivered on the head of the drill by a piston governed by compressed air, consequently the motor is not



FIGS. 3, 4 AND 5.—"LITTLE GIANT" PORTABLE DRILLS.

subjected to serious mechanical strains or vibration. The motor is wound for 110 or 220 volts, the maximum capacity of the drill shown being 1 in., its weight equalling 21·5 lb., and its overall length 17·5 in. The portable electric blower, illustrated in fig. 7, will also operate on either A.C. or D.C. at any periodicity of single-



FIGS. 6 AND 7.—UNIVERSAL HAMMER DRILL AND BLOWER.

phase; for two or three-phase circuits the machine may be operated on one leg of the system, or from a lampholder. A steady pressure of about 6 oz. above atmosphere is delivered from the 1·25-in. orifice. The machine weighs only 15 lb., and is very convenient to handle.

MESSRS. C. E. LUGARD & CO., Nottingham, will show two things of interest to the electrical trade. The "shunt cut" meter affords a simple and convenient method of indicating the output or speed of machine tools in any desired terms. The instrument consists of an ammeter, which has the maximum reading on the left-hand side, instead of on the right; the scale may be marked in FT. P.M., or any other value, to give direct readings of the speed of the driven tool. The ammeter is inserted in the shunt circuit of the motor, and since the shunt current is proportional to the speed of the motor, within certain limits, and the motor speed is proportional to the speed of the driven tool, a relation can be obtained between the shunt current and the speed of the machine tool. Thus, the ammeter is operated by the current in the motor shunt, and the scale reads the speed of the machine tool. The "Vulkan" electromagnetic clutch drive uses external and internal gears, and special switching arrangements by which any cutting or return speed is claimed to be obtainable on a

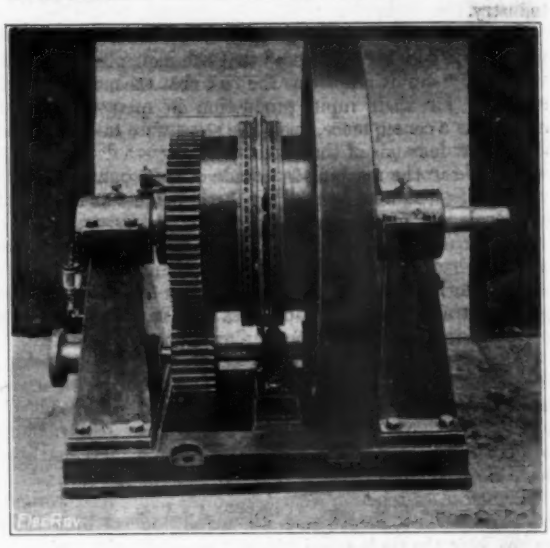


FIG. 8.—A 20-H.P. ELECTROMAGNETIC CLUTCH.

planing machine, in addition to other advantages. Fig. 8 shows a 15 to 20-H.P. clutch equipment suitable for a 4-ft. planer, and fig. 9 is a diagram of connections for open and crossed-belt drive with two cutting speeds and one return speed. The reversing electromagnetic clutch consists of a cast-steel shaft, drilled for central lubrication, on which a disk armature is shrunk, and two electromagnetic bodies running loose on the shaft. Each magnetic body is fitted with an annular energising coil, enclosed in a metal case which is easily removable and impervious to oil or moisture, and wound for any convenient voltage up to 550. A ventilating ring is fitted to each magnetic body to dissipate any heat that is generated. The disk armature is fitted with a wood thrust or friction ring, which can be adjusted or renewed without dismantling the clutch. When D.C. is supplied to one of the energising coils through the slip rings, the loose-running magnetic body, which is mounted on

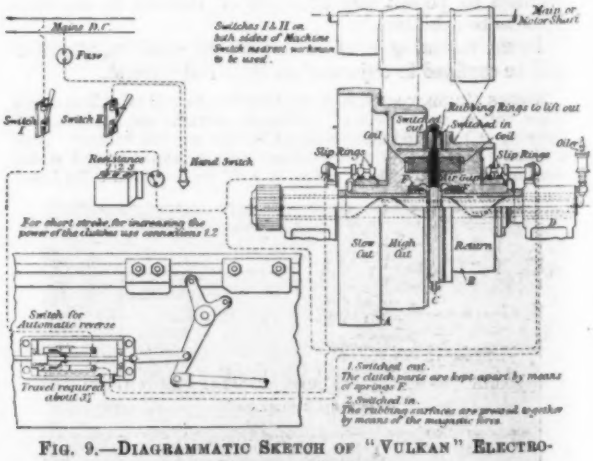

Mains D.C
Fuse
Switches I A II on both sides of Machine Switch nearest workman to be used.
Main or Motor Shaft
Switch I
Switch II
Rubbing Rings to lift out
Switched out
Switched in
Coil
Slip Rings
Oiler
Resistance
Hand Switch
For short stroke, for increasing the power of the clutches use connections 1.2
Slow Cut
High Cut
Return
Switch for Automatic reverse
Travel required about 3/4"
1 Switched out. The clutch parts are kept apart by means of springs F.
2 Switched in. The rubbing surfaces are pressed together by means of the magnetic lines.

FIG. 9.—DIAGRAMMATIC SKETCH OF "VULKAN" ELECTRO-MAGNETIC DRIVE.

a gunmetal sleeve, compresses the springs and advances towards the disk armature (the movement being about $\frac{1}{16}$ in.), thus bringing the ventilating ring in contact with the friction ring through which the drive is imparted to the shaft. The construction of the clutch is such that an air gap is always maintained between the magnetic surfaces, even when the clutch is energised, so that these surfaces cannot wear or stick from residual magnetism. To reverse the shaft, the current is switched by an automatic switch over from one energising coil to the other. No non-inductive resistances are required, and the excitation current can be broken on a pear switch.

The Carborundum Co., Ltd., Manchester, will have a display of abrasives. Carborundum is an artificial abrasive or grinding material, and is a product of the electric furnace. It is taken from the furnace in the form of masses of crystals, which are crushed to the individual crystals of varying degrees of fineness, mixed with bonding materials, and moulded into the many and varied sizes and shapes of stones, files, grinding wheels, powder, paste, &c. "Alaxite" is another product of the electric furnace, and is used particularly for making extra hard fine varieties of the above-mentioned abrasive articles and tools. Carborundum is not only a wonderful abrasive, it is also a super-refractory material. Produced in the intense heat of the electric furnace, it cannot be melted, and possesses an extremely low coefficient of expansion, coupled with high thermal conductivity. Carborundum refractory bricks inherit the remarkable properties of carborundum combined with great hardness and mechanical strength. They withstand the highest temperatures, resist abrasion, and do not spall or crack under rapid changes of temperature. Their value in the upkeep of high-temperature furnaces is definitely established. Carborundum refractories include carbo-frax and refrax bricks, muffles, cements and firesand.

Walter McGee & Son, Ltd., Paisley, will have on view 2·5 and 5 h.p. "Emcol" totally-enclosed induction motors. In size and shape this type of motor is similar to ordinary open motors, but it is so constructed that the windings and vulnerable parts are completely isolated from contact with the surrounding atmosphere. The air circulation is obtained from fans mounted on the rotor shaft, which force the internal air through a series of tubes spaced round the stator, and also the external cooling air through spaces cored in the stator, which, striking on the tubes, serves to keep the internal air cool.

Messrs. Alloy Welding Processes, Ltd., London, are manufacturers of A.W.P. electrodes to weld cast-iron and all classes of steel; also composite electrodes for depositing manganese and high-speed steel for wearing and cutting surfaces, and suppliers of complete welding plant and equipment. There will be shown in actual use a special single-unit motor-generator welding set, the generator of which has been specially designed, and has characteristics of efficiency which make it small and economical. The motor is of only 7·5 h.p., which is a point of considerable importance now that the power consumption has increased to such a large proportion of total working costs. The plant to be shown is designed for a d.c. supply, and is specially suitable for tramway and light railway use where a d.c. supply is readily available. Mounted on a suitable truck and connected to a trolley wire or third rail, the whole plant is very portable, and owing to its light weight, can be easily moved from place to place. There will also be shown a portable welding plant for use on a.c. supplies consisting of a static transformer, special reactance coil, and necessary switchgear. Demonstrations will be given showing that with A.W.P. electrodes highly efficient welding can be done with either d.c. or a.c. plant. A.W.P. electrodes are manufactured in 14 different types to suit all classes of iron and steel, and the demonstrations will give visual proof of the excellent results attainable on all thicknesses of material. A.W.P. electrodes have successfully passed the exhaustive series of tests for Lloyd's Register of Shipping, whose approval has been obtained for their use on ship construction. Samples of electrodes, welds and welded articles will be on show, together with the actual test pieces submitted to Lloyd's Register of Shipping.

The Rapid Magnetting Machine Co., Ltd., Birmingham, claims to be the only firm in the British Empire specialising in magnetic separators. A selection of four types of separators will be shown; probably the most important from the point of view of the mineral mining industry will be the "Rapid" (Thompson-Davies patent) electromagnetic ore separator for treating feebly magnetic ores, such a wolfram-tin, zinc blends, tin sands, magnetic sands, corundum, &c. Prior to the war, the manufacture of apparatus for such purposes was a virtual monopoly of Germany. A feature of the apparatus, which will be shown in operation, is the ease of tuning up, each part of which can be done while the machine is working. Delicate setting can be made in a very short time, and as the effect of any alteration can be instantly seen, there is no time lost in experiments of trial and error. Two machines very largely used in the metal trades are the standard type drum separator, which will successfully treat a mixture of 99 per cent. of iron and 1 per cent. non-ferrous metal, and type B.B., which is specially suitable for treating quickly metal containing only a small percentage of iron. It is also used largely for removal of iron likely to damage crushing and grinding machinery if allowed to get into same. The fourth exhibit will be an electromagnetic drum (type H), in connection with which is a patent feed belt fitted with feelers, which, becoming magnetised by induction, are claimed to add 50 per cent. to the efficiency of the apparatus. The firm lists upwards of a dozen types and over 100 sizes, and claims that there is no problem amenable to magnetic separation which cannot be dealt with by one or other of its different types or modifications.

The Rawlplug Co., Ltd., London, manufactures a fibre plug which obviates the difficulties previously encountered in securing a firm fixing into any material. By the use of the plugs fixing can be accomplished with far greater efficiency and in one-fifth of the time taken by the old method. By means of a steel plugging tool or a brace and bit a hole can be quickly made the exact size required, and then the fibre "Rawlplug" is pushed into position ready to receive the screw. The plug expands as the screw is turned home, thus ensuring a perfectly firm fixing. It is a labour and time-saving device, and results in a neat job, the "Rawlplug" being invisible when in position. They are made in all sizes and lengths for use with any screw. The exhibit will include examples showing how the plug can be used to advantage in different materials. There will be shown different wiring systems fixed with "Rawlplugs" on plaster, switchboard fittings on polished slate, and electric light fittings on glass, marble, plaster, &c.

The Telephone Manufacturing Co. (1920), Ltd., London, will exhibit a complete range of automatic intercommunicating telephones, from single to 50-line, specially designed to meet works and office requirements. Instruments will be shown fitted with visual indicators, round call and secret keys, hygienic mouthpieces, &c. A speciality is made of the "Laryngaphone" hand set for use in boiler shops or other excessively noisy positions. Numerous types of accessories and details, including terminal and junction boxes, electric bells, relays, magnetos, &c., will be on view, and other specialities will include automatic line-finder telephones, "Mixed" service instruments for use on exchange or private lines, and the "Laryngaphone" adapted to all requirements from mine-rescue work to aviation.

(To be continued.)

SUPPLY PRESSURES ON ALTERNATING-CURRENT SYSTEMS.

By R. J. H. Beaty.

On reading a report of the discussion on Mr. Gillin's I.M.E.A. paper, I was pleased to note that Mr. Wordingham advocated a supply pressure of 50 volts for domestic and other small appliances, because that is precisely what I have been advising my friends for the last 17 years.

Nothing retarded electric lighting more than the advent of the tramcar, followed by the misguided eagerness with which many engineers in this country hastened to advise al and sundry that the ideal pressure for a 30-watt lamp was exactly half that which had been found most suitable for driving a tramcar.

Of course the d.c. men had a very good reason for this camouflage, but unfortunately the a.c. men followed fashion rather than reason, and gave away their birthright.

The 200-volt carbon-filament lamp was never a success. It blackened early in life. The candle-power gradually went down and the watts went up. The 100-volt lamp was better, but the 50-volt was better still.

We all remember how the early metal-filament lamps had to be run two in series on 200-volt circuits, and how we were assured that a 200-volt lamp would soon be produced. It was; at a higher price, with lower efficiency and shorter life. The gas-filled lamp is at a still greater disadvantage on 200-volt circuits.

Small single-phase motors of the commutating type would be cheaper, more reliable, and more easily repaired if wound for 50 instead of 200 to 250 volts. Take the Dictaphone motor, for example; it is wound for 20 volts, so when it is used on a 250-volt circuit, 20 volts are utilised and the odd 230 volts are dissipated in the resistance.

200 volts is not a safe pressure. It is more than 20 years since a youth was killed through larking with a lamp bracket in a lavatory. The excuse was made that: "He must have had a weak heart, and the floor was unusually damp." There have been similar cases since, but surely the industry is now so well established that we can afford to drop these weak excuses and face the facts.

There is no need to have a dangerous pressure on lighting fittings or small appliances of any kind. The use of a compensator or auto-transformer does not ensure safety. It is far better to use a double-wound transformer and have the house wiring, or, at any rate, the sub-circuits, entirely insulated from the mains.

Where the distributing mains are at 440 volts, three-phase, single-phase lighting transformers should not have their primaries wound for 250, but for 440 volts, so that no connection need be made to the neutral wire, and therefore it can be dispensed with, thus saving 25 per cent. of the copper. But with the introduction of low-pressure transformers and the abolition of the fourth wire, the distributing pressure could be doubled, so that we could supply the same power with three-eighths of the copper now used.

I suggest that the medium-pressure mains should have a phase voltage of 500, corresponding roughly to 870 line volts. This pressure is suitable for motors of from 3 h.p. to 1,000 h.p., and is approaching the limit beyond which it is advisable to break away from the methods of construction usual with low-pressure motors.

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Induction motors of between 5 H.P. and ¼ H.P. should be wound for 87 line volts, and supplied from a three-phase delta-star transformer, which could also supply the lights from phase to neutral, as shown in fig. 1.

Supply authorities now stipulate that these small motors must be protected by oil-switches fitted with automatic devices costing as much as the motors; so, on existing systems, if one has a few small motors it pays to step down to a lower voltage, and substitute triple-pole switches and fuses for the expensive automatics.

Motors of more than 1,000 H.P. should be wound for connection to the high-pressure mains. High-pressure voltages appear to have been chosen at random in the past, as there are at least six different pressures in use in this country between 5,000 and 10,000-line volts, all of which represent odd figures for the phase voltages, and there would appear to be no reason why a round figure of 5,000 phase-volts should not be adopted for new schemes. This gives 8,700 line volts and 15 K.V.A. per ampere. The high-pressure

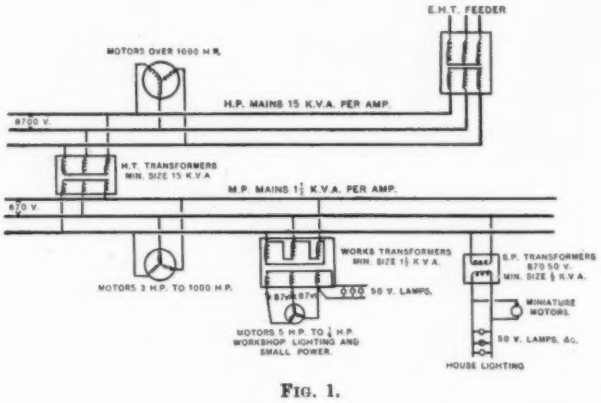


Fig. 1.

transformers for use with the scheme outlined above should be wound for star-star connection, and to obtain sound reliable articles, sizes smaller than 15 K.V.A. should be avoided, and the number of tappings kept down to the minimum. On large extra-high-pressure transformers connecting feeders to the high-pressure mains there should be no tappings at all. Where variation is necessary, it should be obtained by means of separate boosters.

Based on the above considerations, the following definitions may be suggested :—Low-pressure, not exceeding 50 volts to earth ; medium-pressure, not exceeding 500 volts to earth ; high-pressure, not exceeding 5,000 volts to earth ; extra-high-pressure, exceeding 5,000 volts to earth.

The once fashionable pressure of 2,000 volts is not likely to be much heard of in the future. It is high enough to necessitate special insulation of cables, transformers and motors, and too low to transmit any considerable amount of power.

A DOUBLE-ANODE VACUUM-TUBE A.C. RECTIFIER AND WIRELESS TRANSMITTER.

By JOHN SCOTT-TAGGART.

The following description of a novel full-wave rectifier of alternating current may be of interest. A single highly-exhausted vacuum tube (fig. 1) contains two cylindrical anodes, 7 and 6, which surround a common filament 1, which is heated to incandescence. The structure shown is particularly applicable to high-power valves, and more simple tubes are made of small powers and for use in receiving circuits. The source of current to be rectified causes the potentials on the anodes to be of opposite sign at any given moment ; consequently, the flow of electrons from the filament passes to each anode in turn.

Fig. 2 illustrates a practical arrangement for converting A.C. into high-voltage D.C. A source of A.C. feeds the primary 16, of a step-up transformer having two secondaries 6 and 7, which have a common point joined to the filament 3, which may conveniently be heated by A.C. through a step-down transformer 2. The ends 12 and 14 of the windings 6 and 7 are connected to anodes 13 and 15 respectively. Instead of two separate secondary windings, only one may be used, and its middle point connected to the filament, the ends being joined to the anodes. The high-voltage alternating potentials in the secondary windings cause, say, the anode 13 to be positive with respect to 3. An electron current flows to 13, and *viâ* 6, charges up a reservoir condenser 10, which may have a capacity of several microfarads. Across this condenser is connected the load 11, which in wireless telegraphy and telephony is usually the anode circuit of a transmitting valve. Meanwhile the cylinder 15 is negative and attracts no electron current. When the next half cycle comes along, conditions are reversed ; the anode 15 is now positive, and a current flows to 15, through 7, and charges up 10 in the same direction as before. Thus, full-wave rectification is obtained, and both half-cycles are utilised. The current drawn from the condenser 10 is practically pure direct current, the ripple being very small indeed if 10 is large and the current drawn from it is small. A system of chokes and condensers may be used, but is not usually necessary.

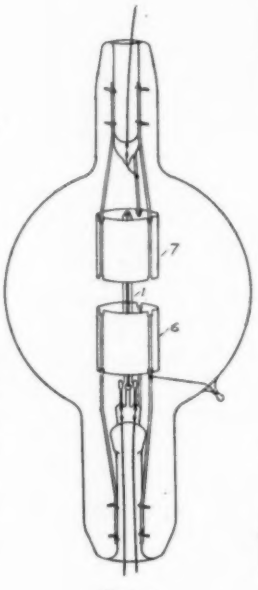


Fig. 1.

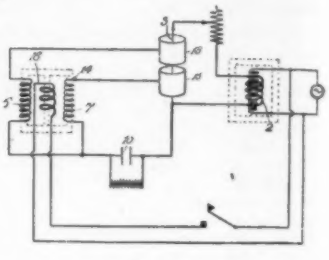


Fig. 2.

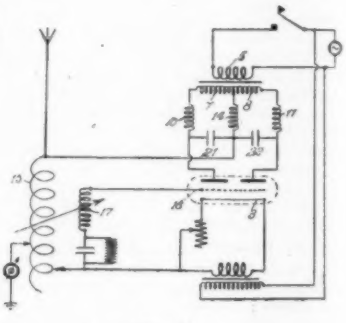


Fig. 3.

It is found that practically the whole of the electron current from the filament passes to the operative anode ; consequently almost half the filament current normally used in other arrangements is saved. The vacuum is identical for both anodes, and the pumping, construction, and final cost, is considerably cheaper than in the case of two single-anode rectifiers.

The third figure shows a continuous wave generating valve circuit. The valve of fig. 1 now has a single grid common to both anodes, and this grid may be used to control the current passing to whichever anode is operative. The rectified current is made to pass through the inductance 15 ; the grid oscillatory circuit 17 is connected across grid 16 and filament 3, and air choke coils 10, 14, and 11, are intended to protect the transformer 5, 7, 8. The condensers 21 and 22 are to by-pass the high-frequency current generated, and also to improve the power factor of the transformer 5, 7, 8 ; other features of the arrangement are shown in the figure. In this manner fairly pure continuous waves may be produced with a single valve and an A.C. supply.

Apart from these uses, the two types of valve mentioned have numerous applications in wireless reception and telephony. The writer is indebted to the Edison Swan Electric Co., Ltd. (which has purchased the British patent rights) for permission to publish the above details.

ELECTRICITY IN THE GERMAN ARMY.

By Major T. RICH, O.B.E.

The following notes are the result of the examination of prisoners, documents, power lines, and depôts in Northern France and Belgium by the author, and are published by permission of the Controller of H.M. Stationery Office :—

In technical matters attention to detail must be one of the almost invariable factors for success, and this applies with special force to military technology. If one nation can obtain the same technical result with simple apparatus or by methods which cost one half or a third of the man power, money, and time to carry out that another nation takes, the former will have a great advantage both during and after the war whichever side ultimately wins.

It is easy to demand elaborate appliances which are difficult to produce during war, and which may arrive too late to be of use. An officer or man who can obtain results good enough for the actual conditions with apparatus improvised from local or easily obtainable materials or items shows his capacity for the work on hand.

Details have, therefore, been given to show what has been done under the difficult economic conditions due to the almost complete lack of copper and rubber and the existence of very limited quantities of coke-oven benzol in lieu of petrol.

There have been apparently no epoch-making discoveries during the war with regard to electric power works, and some of the work done and methods used cannot be considered free from criticism. Both the Germans and the French have shown under peculiar conditions what can be done with simple appliances by those who have sufficient technical training and what might be termed technical pluck.

Policy.—Information obtained in Germany before the war, and the examination of prisoners and machines, show plainly that on the outbreak of hostilities the German General Staff was fully alive to the use of electric light and power as an aid to warfare, and had collected before the war a large amount of useful information regarding electric power systems in France. Soon after the advance in 1914-15 a general electrical survey took place, and a beginning was made with the collection of electrical apparatus for the use of the army or for munition and general industrial work in Germany.

At first the power stations were left in the hands of the owners, but as soon as the situation regarding lubricating oil, liquid fuel, rubber, and copper began to get serious, the power stations, especially in forward areas, were placed under sequestration and worked largely with civil labour under military direction. Among the first large power systems to be utilised was that of the Cie. Electrique du Nord, whose main lines at 45,000 volts reached from Pont-a-Venden, near Lens, to Beautor, via Douai, Cambrai, and St. Quentin.

The main line apparently proved so satisfactory that when the economic situation necessitated the utmost utilisation of the power stations throughout the occupied area, it was decided to use 45,000 volts for the pressure of the main interconnecting power lines in the north of France. At first the armies worked to a large extent on their own account, but the variations of army and lines of communication areas, and the existence of so many inter-area power lines, made some form of central control absolutely necessary.

At first it was assumed that the smaller local stations could supply most of the requirements for electric power, and at the time when textile and other factory machinery was being sent back to Germany a quantity of generating plant, such as steam turbines and boilers was taken up. One set of turbine machinery was sent as far as Constantinople, and other plant to Austria. It was found later that demands for power in the occupied area exceeded previous anticipations, and, further, owing to the shortage of liquid fuel and gas coal, electric light had to be supplied to a number of towns and villages for both civilian and military purposes. In many instances, especially in Belgium, Communes were induced to pay the cost of special high-pressure branches, transformer stations, and low-pressure distributions; the facilities thus paid for were then used by the Germans for hutment and other lighting to the greatest extent.

Owing to this demand it became necessary to utilise the large power stations to a greater extent than before, and the increasing danger from aircraft attack made it very desirable to link up the main power stations to render mutual assistance and to enable them to work with the greatest economy. The loss of Vimy Ridge, which necessitated the shutting-down of Henin Lietard, and the French advance to the neighbourhood of the power stations at Beautor, made such linking-up imperative, and by the end of 1917 an extensive system of 45,000-volt mains was in use or under construction connecting Lille (Croix Wasquehal) with Valenciennes, Jeumont, Hirson, St. Quentin, Laon, and Charleville. The smaller power stations at Ostend, Bruges (steel works), Zeebrugge, Courtrai, Zeveneghem, and elsewhere, were connected by overhead mains at 15,000 volts, inter-connecting transformers being placed at suitable points, such as Flines-les-Raches and Bruges, so that the system at 15,000 volts could supply one at 10,000 or 5,000 or *vice versa*.

When the Germans advanced in March, 1918, steps were immediately taken to reconstruct the lines to Bapaume and elsewhere, and quantities of stores were ordered and delivered. Large reserves of stout poles, steel cross arms, and aluminium cable were collected at the main depot at Jeumont suitable for the bridging of the devastated area. During the retirement in the end of September and October very large quantities of stores were removed from power stations, sub-stations, depots, and dumps, and placed on rail and barge, and long lengths of power line were dismantled. The special efforts made everywhere to salve electrical materials and apparatus in the face of great transport difficulties proves the extent to which the German General Staff recognised the importance of electric transmission as an aid to warfare.

French inhabitants, on whom troops were billeted even in front areas, say that the electric light was in general satisfactory, although in places no aerial cable could stand against the artillery fire which was ultimately experienced. Inhabitants and civilian electricians have stated that the power supply in back areas proved satisfactory. The examination of sub-station log books shows that the supply was reasonably reliable.

Organisation.—The electrical units were developed primarily to take charge of lighting and power installations and captured apparatus in army main areas and lines of communication, and to give technical advice to the troops in forward zones regarding the use of electricity for tactical purposes such as mine lighting, ventilation, and pumping, well boring, trench pumping, and concrete mixing. A certain amount of non-electrical machinery was handled by these units. They were known as Starkstrom (strong current) units as distinguished from Schwachstrom (weak current) telephone and telegraph units. The organisation was very similar to that of signals in the British service, the men wearing special badges, and authority was given to them to enter any building where light and power was officially or unofficially installed.

One Abteilung or battalion was allotted to each army. In general oldish men were used, but no age limit was fixed for good tradesmen.

A certain number of French and Belgian prisoners were returned from Germany to areas where they had local knowledge, and in a few cases were allowed to live in their homes in order to assist in the maintenance of high and low-pressure power and lighting systems. A certain amount of civilian labour, mostly unskilled, was used in repair shops in back areas; for such work as accumulator repair a number of women were employed.

Owing to the fact that the army had first call on skilled tradesmen, and trade unions did not apparently interfere with the supply of electricians and other workers, the senior technical non-commissioned officers seemed to be, as in the French Army, a high-class lot of men. Many of them were foremen electricians, and some of them branch managers or partners in wiring and contracting businesses. Judging by the nature of the drawings found and works carried out, competent draughtsmen and designers were attached to the electrical services.

The work done by Electrical Units was on a territorial basis; large and small detachments were detailed for towns, dumps, and groups of villages. Each detachment had a small depot. The maintenance of main and subsidiary power lines was split up among the detachments. Small areas were under the control of non-commissioned officers. Periodical reports and certificates had to be forwarded through company headquarters regarding maintenance of power lines and state of lighting and power installations in the sub-area.

The close liaison which must have existed between the financial and commercial firms, the German War Office, the General Headquarters, and the officers commanding the technical troops is shown by the quantities of electrical machinery and apparatus, high and low-pressure cable, and other material specially collected and sent to Germany, and the protection given to certain undertakings which owed money to firms such as the Siemens and Halske Co.

Systems in Use.—As a general rule except in the forward zone the system and low-pressure voltage used were those of the supply companies in the areas occupied.

In the first two years of the war a good deal of 3-phase current was used for lighting and other work in the forward 2,000-metre zone. At one time a considerable amount of 3-phase lighting was used by taking single-phase branches into dug-outs, sometimes with the use of earthed returns to the neutral point.

The development of trench telephones and the use of listening detectors made the use of this system in some places very inconvenient, so in a number of forward areas D.C. at 110 or 220 volts was used, supplied from benzol engine sets or motor generators, the latter being frequently supplied through buried cable, and also used to charge accumulators for trench lighting. As a general rule the use of small petrol engines was reduced to an absolute minimum, and every effort made to utilise existing systems.

In most parts of northern France and Flanders 3-phase current at 50 periods is customary, although in Mons, Tournai, and a few other parts of Belgium 42 periods is found. The high-pressure voltages in use are mostly 5,000, 10,000, and 15,000 volts. The power line extensions made into new areas were mostly at 15,000 volts, this being considered the highest pressure at which detailed distribution could be made with inexpensive apparatus. In France the low-pressure voltage was usually 110-120 volts to neutral and 190-220 volts across phases. A pressure of 220-380 volts was being developed in Belgium especially in quiet sectors. By the use of induction motors with wound rotors, the same machine could be used on either of the above voltages, and practically all the new German 3-phase motors found were wound for use with either of these two pressures.

Store Depots and the use of Captured Plant.—A number of main and subsidiary depots were arranged for handling electrical plant and apparatus. Factories in the north of France, and to a smaller extent in Belgium, were systematically stripped of their electrical and steam plant. Manufacturers' and agents' stocks were packed and listed, and the whole forwarded to collecting stations, where they were numbered, sorted, tested, repaired, and then sent into a special depot for issue. Many out-of-date or otherwise useless machines were broken up for the sake of the copper, brass, and cast-iron they contained.

Although most of the large electrical manufacturing concerns in France are found in Paris and outside the invaded areas, electrical factories which existed, such as the Thomson-Houston factory near Lille, and the Ateliers de Constructions Electrique du Nord et de l'Est at Jeumont, were used for electrical repair works.

Up to the end of 1917, with the exception of apparatus required for the newer sections of the 45,000-volt lines, the bulk of the transformers, motors, and general heavy apparatus used was that taken or requisitioned from the occupied area.

The requisitioning, numbering, and listing of French and Belgian machines was most carefully done, the numbers had to be quoted on stock lists and railway way-bills. According to correspondence, machines were at times examined to see that these numbers were in order. Owing to this care it has been possible for the French and Belgian factory and power-station owners to trace and recover quantities of electrical and other machinery from dumps in France, and also from factories in Germany and Austria.

Electrical Stores, Indoor Wiring and Substitute Materials.—The accessories used by the Germans did not differ materially from those customary in civil life; preference was given to simple and inexpensive patterns. Quantities of more expensive French fittings captured in 1914 remained in store unused. French fittings were used to a large extent, and German makers of French pattern fittings forwarded their stocks on hand to army authorities for use on the Western Front. When these stocks of completed fittings were exhausted a number of porcelain parts of French pattern were fitted with galvanised contacts and conducting parts.

It was found that some of the contacts and connections made of iron inside low-pressure fittings had been badly galvanised, the process used being apparently electrodeposition. The wiring used was done on cleats and knobs, but a certain amount of work was done in Bergmann paper-lined steel tubes.

The manufacture of wire and cable from substitute materials began at an early date. Stranded iron, zinc, and latterly aluminium was used for low-pressure insulated conductors. One difficulty with iron conductors lies in the small size of the contacts usually found in fittings, and the comparative stiffness of the insulated conductor, which is liable, when care is not used, to cause short circuits in fittings. Some of the iron of the insulated conductors was of poor electrical quality, giving a resistance ten times that of copper. Some of it was specially soft, giving a resistance of six to seven times. Lamp flexibles were made with iron wire.

Owing to the absence of rubber, oiled paper, bitumenised paper, and bitumen compound were used for insulation. A cellon tape was used with paper-insulated cables for jointing. Some of the iron cable had very poor quality insulation, consisting of one layer of paper and braid. The Germans, like the French, apparently made no attempt to use a high-grade, expensively-insulated wire for cleat and knob wiring in huts and offices, looking upon the covering largely as a mechanical protection. Owing to the absence of jute, impregnated stranded paper was often used for braiding.

According to prisoners, little difficulty was experienced through the use of low-grade insulated wire.

A considerable quantity of 10-mm² (about 9 S.W.G.) solid aluminium wire was found paper-insulated, lead-covered with bituminised jute and paper sheathing. This was apparently used for lighting dug-outs in trenches, and it has been stated by a prisoner that the lead sheath was used for the return circuit. A number of drums of 50-mm². 19-strand iron cable, with paper insulation, was found. This was first used on 1,500-volt electrified barbed-wire circuits, and later was used to a certain extent for general wiring work. The use of iron for motor and similar connections led to a heavy drop in voltage.

Electricity meters were rarely used; civilians were usually supplied with light on a fixed price per lamp per month.

(To be continued.)

ELECTRICALLY GUIDED SHIPS.

It is now common knowledge that during the late war the British Admiralty made use of the electric "leader" cable for the purpose of guiding ships through narrow channels or along dangerous coasts. It is obvious that, with the aid of a submerged cable along which electrical signals are sent, ships may, in times of war, be guided safely through mine fields; or on the other hand, in more happy times of peace, the method would render ships independent of pilots and would enable any vessel to enter a dangerous harbour in the thickest fog, or on very dark nights, without any previous knowledge of the locality.

What appears to be the first post-war application of the method was the subject of the announcement in March last, that the Admiralty had installed a "leader" cable in the approaches to Portsmouth Harbour. The cable, which is an armoured one, lies at the bottom of the fairway, the land end being connected with an alternating source of supply. Interruption of the current corresponding to prearranged signals of the Morse code conveys to ships fitted with the necessary receiving apparatus their position in the fairway to within 500 yards of either side of the cable.

Early in August the United States Navy Department announced its intention of testing the method in guiding ships up the Ambrose Channel into New York Harbour. It is proposed to utilise a cable about 16 miles long, connected to a 500-cycle alternating-current source of supply, the indications of which, it is believed, will be picked up by all vessels within half a mile. The cable is to be laid on the bottom of the harbour from Fort Lafayette, on the Brooklyn side of the Narrows, near Fort Hamilton, out to the Ambrose Channel lightship. In foggy weather shipping is at present piloted up to the lightship by means of five wireless direction-finding stations situated at different points in the harbour.

The French Navy also fully appreciates the advantages of the electric submarine cable for facilitating navigation in thick weather, and on August 21st, M. Landry, Minister of Marine, witnessed experiments that were conducted off the coast of Brittany.

From what has been said, it will be readily appreciated that the "leader" system is likely to prove of very valuable assistance to navigators of ships when low visibility prevails. It will do much to increase safety and efficiency at sea. In the past many vessels have been lost for the lack of means for sufficiently accurate guiding in dangerous channels and in fog. Moreover, vessels are often held up for considerable periods of time at harbour entrances; for instance, at New York, where the financial cost for delay may amount to as much as £500 per hour for a single ship. It is believed that re-occurrence of such losses may be greatly minimised, if not altogether prevented, by the "leader" system of pilotage.

Obviously the exact types of cables, instruments, and signals used would vary with local conditions and resources, but it is fairly clear that the cost of the installation would be amply repaid in a very short period by the time saved by vessels in foggy weather, freedom from accident, &c.

The signals are picked up by means of detector gear fitted in the bottom or at the sides of the ship, and are rendered audible or visible as the case may be by telephone or galvanometer attachments. The strength of the signals being kept at the maximum indicates to the navigator that the ship is following the proper course; the signals can also be so arranged as to give the distance from either end of the channel. There would, of course, be separate cables for ingoing and outgoing traffic. The signal-carrying conductors may be installed along the sides or at the bottom of the channel; the latter position would probably be the more practical one.

The following data relative to the subject under consideration were abstracted from the *Journal of Electricity* and the *T. & T. Age.*

The ship receiving device may consist of a coil of wire on an iron core attached to the bottom of the ship with the core athwartship for receiving from a submarine signal wire or vertically to the side of the ship for receiving from a wire parallel to the channel. Where conditions will permit, the signal may be the spoken word "In" for the inbound channel and "Out" for the outbound channel. If desirable and conditions permit, different frequencies of alternating current may be impressed on the guide conductors, one frequency for inbound and one for outbound. These signals may be picked up by both telephones and a signal-strength-indicating device, as for example, a sensitive ammeter or galvanometer in a circuit resonant to the frequency of the current impressed on the guide conductor. With two or more such indicating devices the relative strengths of the fields of the inbound and outbound signals and the relative strengths of fore and aft and athwartship fields may be ascertained. Also by controlling the strength of the signal in accordance with the distance from a given point, for example, by earthing a portion of the current through suitable resistances at fixed distances from the source of supply, the strength of signal would be relative to the distance from that source. Such indications of strength of signal relative to the source of supply (*e.g.*, the dock) and relative to the inbound and outbound signal conductors, and relative to the angle the ship makes with the

signal conductor, offer the means for a comparatively high degree of accuracy in steering the vessel clear from danger.

A further complexity of circuits may be provided which will afford sufficient accuracy in certain places, for example, the guide may consist of several conductors in one cable, the conductors being of several suitable lengths and suitable speech currents being impressed on them. For example, one conductor could carry a speech current which says periodically "One mile in," while the next in length would say "Two miles in," and the outbound signal wire in that vicinity might say "Nine miles out." The ship's receiving circuits may be arranged fore and aft and athwartship in such manner as to indicate whether the ship is approaching the signal conductor or leaving it or is parallel to it or at some angle to it.

Structural conditions of ships, channel conditions, financial and political conditions have their bearings on what structural arrangements would be best to carry out the method. For example, in New York harbour it would probably be practicable to provide all possible refinements and strong accurate signals which could be followed both by vessels equipped with simple and by those with more expensive and more highly accurate apparatus.

In the long passages in Alaska it may be practicable and sufficient for the present to follow the army cable lines. This may be made possible by picking up the telegraph signals and guide signals which might be supplied by the army at intervals between telegraph signals.

To do this is more difficult than would be the case if the cable were made for directing purposes, because Army cable currents are weak and the cable is covered with a sheath containing iron. Also, the resistance, inductance and capacity of the long cables limit the quantity and kind of signals that may be impressed on them.

However, there are several ways which can be used as may be necessary to pick up the weak cable signals, although they are in an iron sheath.

For example, the pick-up circuit (which can be relatively small) may be lowered from the ship to near the bottom and maintained in the same relative position to the ship; also prescribed frequencies may be used on the cables and tuned receiver circuits, and very weak currents may be amplified. The receiving circuit may include a coil virtually wound around more or less of the hull. One coil could be wound in a fore and aft plane and another in athwartship plane, or a coil or coils inside or above the hull, depending on practicability.

Portions of the guide conductor may be enclosed in iron for reducing the signal strength at desired points or for desired sections. Such arrangement might prove desirable for certain of the conductors where several conductors are used. One conductor might have the words "Port ninety" for a sharp turn, and be in iron beyond the turn. It may be desirable to make the incoming and outgoing guide conductors into a circuit, instead of having an earth return for each, or it may be desirable to have a common metallic return conductor for both. The return conductor might be bare wire. Some conditions might permit the use of a bare wire conductor on shore on insulators with a return bare conductor circuit under water, the bare conductor being of such low resistance that it would be the principal current path, and so serve as a guide, cheaper than where under-water insulation was used.

The signal current in the conductor along the channel may be like that in the antenna of a radio transmitter, and the radio receiving outfit on shipboard may be used to receive it, using a regular antenna or a coil. Also, the coil might be revolvable on its axis so that it could be turned to pick up the signal and then the boat turned so that it had the proper fore and aft position relative to the coil, and, therefore, was headed right in the channel.

At this date it is hard to say what is the most practical arrangement to use. It may be best to make the best direction control apparatus irrespective of the radio apparatus, and leave the latter free to handle other things.

A wave-length of 15,000 m. probably could best be impressed on a submerged insulated wire about 3,000 metres, or two miles long if the wire was earthed at the one end, probably the end near the transmitter generator. That frequency probably would do well in even longer wires or a succession of wires one mile long inductively or otherwise coupled at the ends, in which case the ship in passing over the points of coupling would note differences every mile, which would be used as a measure of distance and further contribute in the matters relative to location. All things considered, possibly the most practicable form for common service would include a standard frequency for all ocean-going vessels and for all ports of, say, 750 cycles, and enough current in the signal circuit so that the receiving circuit would not necessarily include anything but a revolvable coil on top of the pilot house, a fixed condenser and a pair of 'phones with an indicating dial and coil-turning handle in the pilot house.

Such a frequency is applicable to quite long wires, and long wires might be required in some places. Also, such a sinusoidal frequency and current can be fairly easily obtained from a dynamo and maintained with very small percentage variation. And such a receiving coil and condenser and 'phones can be maintained comparatively constant. Sinusoidal current and the frequency of 750 or 1,500 would serve to cut out some interference, those frequencies being different from the commercial 60 cycles, radio generator 500 and 1,000 cycle frequencies, and sufficiently different from common motor and dynamo commutator and field frequencies. The average ear is probably most sensitive to about 750 cycles, but quite sensitive to 1,500 cycles.

Special vessels (*e.g.*, ferries) which do not use regular channels, probably should be provided with additional special frequencies. On the Alaska cable route special very low frequencies, perhaps twenty cycles or less, would be more practical. It might be found that the longest Alaska cable run has a minimum impedance for a frequency of four cycles or less.

The theory of the magnetic field surrounding an immersed cable when carrying an alternating current is of interest, and was dealt with in the *Revue Générale de l'Electricité* for December 20th, 1919. Also some results of an investigation of the magnetic field in the neighbourhood of the surface of the water covering a cable carrying alternating currents of various frequencies, which was made in 1918 by the Under Water Signalling Section of the Kiel Torpedo Inspection Department of the German Navy, were given on p. 691 of our issue of May 28th last. An article on the same subject by Mr. H. R. Rivers-Moore, B.Sc., appeared in our issue of August 29th, 1919.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Single-phase Meters on Balanced Three-phase, Three-wire Systems.

With reference to my letter which appeared on page 138 of your issue of July 30th, there was a clerical error in the last paragraph, which should read as follows:—

"For indicating instruments, however, which simply have to show the power being absorbed at the moment, a single-phase instrument, owing to its simplicity of connections, is often to be preferred. For indicating the power consumed by a large motor, for example, there is no objection to a single-phase instrument being used."

C. C. Garrard.

Witton, Birmingham.
August 27th, 1920.

The So-called Half-watt Lamp.

Lamp manufacturers have now brought on to the market two new sizes of gas-filled lamps (so-called "half-watt") these being 100/130 volt, 40-watt, and 200/250 volt, 60-watt. The price list of one of our leading manufacturers prints these new sizes in red, and in defining the half-watt type lamp points out that the consumption is approximately 0.5 watt per C.P.

There is no doubt that the public in general, and the majority of those more intimately associated with the electrical industry are under the impression that the half-watt type lamp does give approximately 2 C.P. per watt. This absolutely false assumption is most damaging to the electric lighting industry, as it is sure to result in the indiscriminate use of these gas-filled lamps, particularly the above-named low-wattage ones.

The fault lies in the fact that the metal filament and half-watt type lamps are rated in watts, and are not sold under any guarantee as to the amount of light they emit.

The new unit of light rating for lamps, the *Lumen*, expresses in an accurate way the value of the total light flow (in all directions) from a lamp, and is the amount of light which will illuminate one sq. ft. of surface to the intensity of one foot-candle. The Lumen therefore should be used as a basis for the comparative efficiencies of lamps.

Utilising data from manufacturers' lists, I find the following:—

200/250 VOLT.

Metal Filament.			Half-Watt Type.		
Watts.	Lumens.	Lumens per Watt.	Watts.	Lumens.	Lumens per Watt.
20	147	7·35	60	620	10·26
60	515	8·60	1,500	26,000	17·33

The number of lumens per watt of the 1,500-watt half-watt lamp is 69 per cent. greater than in the case of the 60-watt of this type, but despite this, the manufacturer's price list from which these figures are taken, heads the schedule with the definition of efficiency quoted above "0.5 watt per C.P." If one is half-watt the other is not, that is very obvious; but as a matter of fact neither is.

Now we come to the most interesting comparison: The 60-watt metal-filament lamp costs 3s. 6d. and emits 515 lumens, whereas the 60-watt "half-watt type" lamp costs 7s. 6d. and emits 620 lumens; an increase therefore in lighting efficiency of 20 per cent. only (not 100 per cent., as is generally supposed) for an increased cost of no less than 114 per cent. Also the life of the half-watt lamp is considerably less than that of the metal-filament type.

There are undoubtedly cases, mostly in domestic house lighting, where these new low-wattage lamps will be found beneficial if not quite so inexpensive as the metal-filament lamp, but speaking in general terms and for industrial work in particular, the new low-wattage half-watt type lamps are not a sound proposition commercially, that is to the user; to the manufacturer it is doubtless otherwise.

The concentrated nature of the filament gives one the impression that the half-watt lamp is a very powerful one, and few would as a result of a practical demonstration believe, without further evidence, that the 60-watt half-watt gives 20 per cent. only more light than the 60-watt metal, *but as per manufacturers' price lists it is so.*

As one interested in the contracting business, I protest against the issue of such misleading information in makers' price lists, as it is quite difficult enough to educate the user in matters connected with illumination without having to contend with such false definitions as: "A half-watt type lamp consumes 0.5 watt per C.P.," when it does nothing of the sort.

E. W. D.

August 30th, 1920.

Power Factor.

Again we are treated to a dose of power factor by Mr. C. Turnbull, viz., in your issue of August 27th, and as he enlarges on the desirability of frankness in criticism, perhaps I may be permitted to be perfectly frank.

Mr. Turnbull reiterates his horrible analogy about the man going to the bank where he does some very wonderful juggling with cheques, but now goes one worse by quoting as an analogy the case of a compressor driven by a D.C. motor which does no useful work, although it expends a considerable amount of power (actual power, not apparent power) to the extent of perhaps 26 or 30 per cent. of the total output of the compressor, this being absorbed in efficiency losses of the motor running as a motor and dynamo respectively, and also of the compressor itself. This further analogy is absurd in the extreme as the motor in question would actually absorb a considerable amount of useful current, and to compare this to apparent power or wattless current would only lead the consumer into further difficulties in trying to understand this difficult problem. Again, Mr. Turnbull says that a large consumer may take 1,000 K.V.A. of wattless current without paying for it, which I think is absurd, as obviously a consumer would not be taking 1,000 K.V.A. of wattless current unless he were taking a considerable amount of true energy, in this case to the extent of perhaps 3,000 KW., and it stands to reason that the supply authority in negotiating rates for supply will have assumed a reasonable power factor, say, 80 per cent., and will have based its rates accordingly, so that a large portion—perhaps the whole—of this 1,000 K.V.A. wattless is actually paid for.

Mr. Turnbull goes on to say in regard to synchronous motors that "it may happen that the running of a large synchronous motor at leading P.F. may do so much to reduce the load on the system that it would pay the supply authority to supply energy free to the consumer who had it."

Let us take an example:—

A synchronous motor with an input of 200 KW. is made to run with 0.7 P.F. leading (to run with higher leading power factor is usually not sound commercially), *i.e.*, the *wattless leading component* of the load is approximately 200 K.V.A., the total input of the machine being 286 K.V.A. at 0.7 P.F. leading. This machine, therefore, would be able to correct the power factor of 286 K.V.A. of industrial motor load at 0.7 P.F. to unity P.F.—a saving in demand of 86 K.V.A. Even under best conditions the saving would not be more than approximately 100 K.V.A.

This reduction of 100 K.V.A. is worth to the supply authority about £4 per K.V.A. per annum, or £400, whereas the synchronous motor, even with 20 per cent. load factor, would consume approximately 350,000 units per annum, which at 1d. = £1,460. The supply authority, therefore, would be the losers by the difference, *i.e.*, £1,060 per annum. It is evident, therefore, that Mr. Turnbull has not sufficient knowledge of his subject, or imagines that supply authorities are philanthropic institutions.

The analogy of the man on the "push-bike" leaves me speechless.

The crux of the whole thing is that Mr. Turnbull has got hopelessly mixed up between power and apparent power, as he refers to both as power in his analogies and elsewhere, and instead of helping to elucidate the problem, his efforts, as far as I am concerned, lead entirely in the other direction.

All this about sausages, push-bicycles, oil engines, compressors, &c., is wholly unnecessary if the one who is dealing with the consumer (and I speak from experience) has the consumer's confidence and sufficient common sense not to burden him with explanations and analogies in which he is not in the least interested.

Numbers of power supply authorities, presumably unknown to Mr. Turnbull, are to-day charging on a K.V.A. demand basis, and meters *are in use* which indicate the demand in K.V.A., even on unbalanced three-phase, 4-wire systems.

As I pointed out in an article published in the issue of the Electrical Review for October 17th, 1919, and in succeeding issues, *it is useless to try and argue the point with the consumer who can't or won't understand the question of power factor, but the thing to do is to charge him on a* K.V.A. *demand basis, and so touch his pocket, when he will very quickly come to his senses.* It is really akin to the old saying "spare the rod and spoil the child."

Frank criticism was asked for, and I have given it gratis, and must leave Mr. Turnbull to the mercy of other critics.

Enfield. E. W. Dorey.

August 30th, 1920.

Why is the Contractor Permitted to do it?

In common with many of my fellow citizens, I have been "canvassed" on the subject of investing any capital I may be lucky enough to possess in 6 per cent. Housing Bonds. My interest being aroused, I took an opportunity recently afforded me to inspect a number of the houses on which some of this money will be expended.

The houses in process of erection by a contractor working to a Ministry of Health specification were being "wired" for electric light. Under these circumstances I expected to find that the wiring would be carried out in accordance with the I.E.E. Wiring Rules, but, at any rate as to Rule 63 (*a*), this was not the case, as ordinary "push-joint" conduit without continuity fittings was being installed.

Are we, then, to assume that the Wiring Rules Committee is regarded by the Ministry of Health and local building "authorities" as a "wash-out"? And, further, since Rule 63 (*a*) is quite definite on the subject of push-joint conduit, why do supply authorities connect such installations to their mains, in view of the fact that most of them require the installation to comply with I.E.E. rules?

Again, how does a tenant (not in these cases a purchaser) stand in the matter of insurance? since the majority of insurance companies require compliance with the I.E.E. Rules, and in the case of these officially approved houses, the I.E.E. rules are ignored both by the building "authority" and the supply "authority."

Referring to recent correspondence in your hospitable columns, I am impelled to inquire—"Why is the contractor permitted to do it?"

A Contractor's Managing Engineer.

August 31st, 1920.

Automatic Street Lighting. — Any innovation that affords an opportunity of eliminating manual labour is welcomed in these days of high-priced labour. In this connection our recent note in these columns on the method of automati cally controlling street lamps by means of selenium cells seems to have conveyed a wrong impression. It appears to have been assumed that another method of switching on and off street lamps, which was initiated some years ago, is in abeyance.

We refer to the "Handyell" system, a joint invention of Mr. W. Duddell and Messrs. Handcock & Dykes, which was fully described on pp. 325-7 of our issue of February 21st, 1913. The Oliver-Pell Electric and Manufacturing Co., Ltd., is handling the system, and, contrary to popular belief, it is very much alive. Indeed, the method is in everyday use in a number of places in this country, and fulfils the conditions required of it in a simple and efficient manner. It is also by no means unknown abroad.

The underlying principle is to control relays, which may be inserted anywhere on the general system of mains, by means of a superimposed current impressed on the main current flowing in the system. The main current may be either A.C. or D.C., and the apparatus is ingeniously designed and compact in nature; it may be relied upon to perform its functions efficiently, and is automatic, the pressing of a button being all that is required to set it in operation.

It may be mentioned that it is possible to control a single lamp out of, say, 2,000 independently without affecting the others. The system has a number of advantages, for once the apparatus has been installed, it can be employed for other purposes besides controlling the street lighting, at practically no extra cost. For instance, it may be used to control distant meters, sub-station gear, or even to give consumers on the mains daily time or other signals. Other uses to which the device can be put will be apparent to those interested in the subject of automatic control.

Australian Market.—Pointing out that in the great majority of cases the commercial community in overseas centres is a comparatively concentrated and small one, Mr. S. B. McGregor, H.M. Senior Trade Commissioner for Australia, reports that every fault or foolishness perpetrated by the home manufacturer or merchant is talked about and magnified out of proportion to its real significance. According to the report, there is a deep-rooted conviction among many Australians that "the British manufacturer is intensely conservative, unenterprising, generally out of date, and rapidly losing his hold on the world's markets." These allegations are directed against the manufacturer rather than the merchant, and particularly against manufacturers connected with the machinery (including electrical), motor car, small tool, hardware, and allied trades.

BUSINESS NOTES.

New Postal Subscription Rates.—Owing to the increase in the postal rates on newspapers in the United Kingdom, the subscription rates to the Electrical Review will, in future, be as follows :—

One year...	£1	14	8
Six months	0	17	4
Three months	0	8	8

The Colonial and Foreign rates remain as at present.

Our Electricity Supply Handbook.—It is essential for manufacturers and distributors of electrical appliances to be in possession of information regarding the *nature and pressure* of the electricity supply in towns to which their products are being sent. Other facts in connection with the supply, such as methods of generation, type of plant, boiler capacity and prices charged, are of lesser importance, although required on occasion. To meet this need of the electrical industry, we have aimed to give the essential information in as small a compass, and at as low a price, as possible. This we have achieved in our "List of Electricity Undertakings," now to be obtained at these offices. After circularising municipalities and power companies in all parts of the world, we have collected information respecting about 1,500 stations at home and abroad. The particulars given are the names of the supply authority and the chief engineer, the nature and pressure of supply for lighting, power, &c., and the capacity of the plant. The whole is contained in 40 octavo pages, price 2s. net, or, post free 2s. 2d.

Bankruptcy Proceedings.—W. T. Smith, electrical and mechanical engineer, Victoria Street, and 60, Hampden Street, Bolton.—Following scheme sanctioned by the Court :—Fees percentages and cost and preferential debts to be paid in full, and 5s. in the £ to all unsecured creditors by instalments. Receiving order discharged.

A. Kershaw and C. H. Wood (Kershaw & Wood), electrical engineers and merchants, Dewsbury.—Trustee, Mr. C. Turner, 155, Norfolk Street, Sheffield, appointed August 24th.

Company Liquidations.—Arthur Lyon & Wrench, Ltd.—Particulars of claims to be sent to the liquidator, Mr. R. J. H. Ryall, Victoria Road, Willesden, N.W., by September 30th.

Electric Smelting Co., Ltd., and the S. D. Investment Syndicate, Ltd.—Meeting of members, October 6th, at 4, London Wall Buildings, E.C. Liquidator, Mr. G. A. V. Narraway.

Commercial Electrical Accessories, Ltd.—Meeting of creditors is called for September 10th, at the Institute of Chartered Accountants, Moorgate Place, E.C. Liquidator, Mr. N. Bell.

Private Arrangement.—*Re* John Smallwood, electrical engineer, 7, High Street, Hitchin. The following are creditors :—

Barker & Son, P. H.	£3	Hodges & Co.	£68
B.T.H. Co.	35	Loftus, Ltd.	8
Chalkley & Son	28	Siemens Bros. Dynamo Works	40
Crompton & Co.	7	Sanders & Sons	11
Callender's Cable Co.	18	Siemens Bros. & Co	21
Counbrough, J. W.	5	Tucker & Co., J. H.	4
Drake & Gorham	35	Veritys, Ltd.	3
Emanuel & Sons	21	Walsall Hardware Mfg. Co.	41
Edison-Swan Electric Co.	9	Weeks., Ltd., L.	13
Ellis & Everard	25	Waters & Sons	80
Falk, Stadelmann & Co.	39	Hitchin and District Gas Co.	6
Fuller's United Electrical Co.	4	Bankers	9
General Electric Co.	56	Durham, Ltd., W. H.	100
Glover & Co.	42		

Trade Announcements.—Mr. H. W. Booth, electrical engineer, of Princes Road, Margate Road, Ramsgate, has disposed of the business to Messrs. H. G. Maxted & F. G. Lyne.

Mr. Albert Maund, electrical engineer, of Southport, has opened new showroom premises at 9, Houghton Street.

Mr. Percy Moffitt, late with the Northwich Electric Supply Co., has commenced business as an electrician at 35, Faraday Road, Winnington.

Messrs. Jones & Pordes have appointed Messrs. Simm and Richardson, Custom House Chambers, Quayside, Newcastle-on-Tyne, sole selling agents for the Northern Counties (Northumberland, Durham, Westmorland, and Cumberland).

Mr. Lascelles Parrington, A.M.I.E.E., Collins House, 360-366, Collins Street, Melbourne, has been appointed sole agent in Australia for Wild-Barfield electric furnaces.

Catalogues and Lists.—Messrs. C. A. Vandervell and Co., Ltd., Acton, W. 3.—"Running Instructions for the C.A.V. Magneto," pp. 8 ; figs. 2. A little booklet which should prove useful to magneto users.

Messrs. Prices' Co., Ltd., Battersea, S.W., 11.—A brochure, pp. 12, written from an historical and practical point of view, and dealing with Diesel and semi-Diesel engines.

Messrs. Johnson & Phillips, Ltd., Charlton, S.E. 7.—New illustrated catalogue (12 pp.) of oil switches, switchboard-mounting pattern. With full descriptions and dimensions.

City Electrical Co., Ltd., 1, Emerald Street, Holborn, W.C. 1.—Leaflet dealing with "City" light and power plants of outputs ranging from ½ to 11 kw. Giving full prices and particulars of sets, switchboards and storage batteries.

Messrs. Ferranti, Ltd., Hollinwood, Lancashire.—A set of abbreviated catalogues of meters, D.C. and A.C., prepayment meters, ammeters and voltmeters, relays, instrument transformers, and power transformers. These catalogues are issued separately in English, French, Italian, Spanish, Portuguese, Scandinavian, and Dutch ; metric weights and measures are used throughout, and the prices are stated in decimalised coinage. We congratulate the company on this admirable policy—using the language, coinage, and weights and measures of each country—which is indispensable to the full development of export trade.

Messrs. Siemens Bros. & Co., Palace Place Mansions, Kensington Court, W. 8.—New and enlarged edition of catalogue 537, dealing with a large selection from 600 different types of dry cells and batteries manufactured at the company's Woolwich works. The preface contains some useful notes on care and maintenance.

Messrs. Christian Bergh & Co., Bank Chambers, 329, High Holborn, W.C. 1.—Five leaflets dealing respectively with :—Transformers of various types ; high and low-pressure switch and fuse gear, &c. ; electric light fixtures ; various small electrical accessories and cable joint boxes.

The Electric Heating Co., George Street, Croydon.—Illustrated post-card, advertising the "Elect" iron of different weights and loadings. Fully priced.

The J. G. Brill Co., Philadelphia, U.S.A.—"The Birney Safety Car and some interesting results of its operation." Publication No. 245 (32 pp.). A well illustrated brochure, descriptive of the small light-weight "Birney" tramcar.

St. Helens Cable and Rubber Co., Ltd., Warrington, St. Helens.—Works "Text" No. 1, decrying dirt, waste, and untidiness, and mounted on cardboard.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Latest edition of low and medium-pressure switchgear catalogue (48 pp.). A fully illustrated and priced list of switch and fuse-gear for all purposes, including battery, main and shunt, field-breaking and voltmeter and ammeter switches. Also Leaflet No. V-2,339, "Fresh air by electricity," illustrating the "Koolah" ceiling fan.

The Westminster Tool and Electric Co., Westool Works, Putney Bridge Road, S.W. 15.—Two leaflets dealing with the "Westool" D.C. portable electric drill, with illustrations and dimensions.

Dissolution of Partnership.—Cook & Co., electrical and mechanical engineers, 62, Holly Lane, Smethwick, 7, Ingestre Road, Stafford, and New Street, Dudley.—Messrs. S. P. Cook and B. R. Churchill have dissolved partnership. Debts will be attended to by Mr. B. R. Churchill, who will continue the business under the same style at New Street, Dudley.

General Federation of Trade Unions.—Mr. W. A. Appleton, secretary, in his review of the work of the above Federation during the quarter ended June 30th last, states that during that period there had been 86 disputes, involving 22,688 members. The largest and most costly dispute was that of the London piano workers, where 5,500 workers were directly affected. The membership of the Federation was 1,548,591, and the two-million mark did not seem impossible.

New Belgian Electrical Co.—A new company, to be known as the Etablissements De Man, has been founded at Antwerp for the manufacture, repair, installation of and trade in all kinds of electrical instruments and apparatus, especially those employed in the medical application of electricity and in wireless telegraphy. The capital of 1,000,000 fr. is represented by 2,000 shares of 500 fr. each. Eight hundred and sixty shares have been allotted to the Electricité De Man et Cie. in return for the whole of their assets and liabilities ; the rest of the shares have been subscribed and paid up to the extent of 50 per cent.—*Reuter's Trade Service.*

Passports for Italy.—A further relaxation in the passport arrangements for visiting Italy is announced by the London office of the Italian State railways. British and American subjects can obtain from any Italian Consulate a visa for six months, available for any number of journeys to and from Italy within that period without any further formalities. This, with the French yearly visa, now renders matters very simple for visiting Italy. Having obtained these two "period" visas, travellers need not visit any Consular offices (French, Italian or British) either before starting for Italy or before returning from Italy to this country through France, however many journeys are made to and from Italy during the period of validity of the visas. The fee for this new visa is the same as for the old single-journey visa, *i.e.*, 8s. No registration with the police in Italy is necessary, as the hotels themselves report the name and nationality of all visitors.

Trade Union Congress.—The Trade Union Congress opens at Portsmouth next week, and in view of the present critical labour position, special importance attaches to its deliberations. The Trade Union Parliamentary Committee left London for Portsmouth on August 29th. The Congress is favoured this year with one of the strongest of labour leaders as chairman ; Mr. J. H. Thomas in his presidential message will make a pronouncement on the whole situation. The chairman's address is, of course, a personal statement, but it has a powerful influence on subsequent discussions of policy. Numerically by delegation and actual representation the Congress will be the largest yet held. Approximately six million workers will be represented.

Port of London Lock-Out.—Agreement having been reached between the London District Committee of the Electrical Trades Union and the Ship Repairers' Association, the lock-out, which affected 600 electricians, came to an end last Friday.

Book Notices.—"Municipal Year-Book for 1920-1921." London: "The Municipal Journal," Ltd. Price 21s. net.

Conquest for September contains articles on the use of wireless telephony for fighting fire, the photography of projectiles with the electric spark, the Entz system of electric power transmission used on the "Crown-Magnetic" automobile, the hardening of steel, and aluminium.

"Electric Furnaces in the Iron and Steel Industry." By W. Rodenhauser, J. Schoenawa, and C. H. Vom Baur. Third Edition. Pp. xxi + 459; 133 figs. London: Chapman & Hall. Price 24s. net.

"Vickers News." Vol. II, No. 22 (15 pp.).—This issue of the magazine has a description of the "Darenta" toy factory at Dartford. Notes on the manufacture of concrete tiles and bricks are given considerable space, and an illustrated article on the manufacture of disk wheels for an Indian railway is included.

Diesel Engines in Australia.—The Commonwealth Government is seeking to encourage the manufacture in Australia of Diesel engines. In pursuance of this object, a Customs by-law has been approved permitting the free entry into the Commonwealth of one Diesel engine to each firm of engineers which agrees to send a specially-selected, technically trained engineer to Switzerland to assist in the construction of the engines at the works of the makers, who will train the men in the intricacies of the work; it is proposed that such engineers should subsequently supervise the construction of similar engines in Australia.—*Tenders.*

Telegraph Company's Profit-Sharing Scheme.—The Western Union Telegraph Co., in pursuance of a profit-sharing policy, announced more than a month ago, last week began paying to employés all over the world nearly $2,000,000. This additional remuneration represents a share of the company's earnings during the first six months of 1920; each employé receiving 54 per cent. of his January earnings. The payment for the last half of the year, based upon July salaries, will be made on February 15th, 1921.—*Reuter's Trade Service.*

The Engineering Trades Dispute.—All attempts to bring about a settlement of the dispute between the Electrical Trades Union and the Engineering Employers' Federation during the past week failed; on Saturday last the lock-out notices were issued, will take effect in most cases to-morrow. The E.T.U. has given its Executive power to retaliate by calling a national strike. A conference of other Unions affected by the dispute was to be held on Wednesday last.

On Monday, representatives of the E.T.U. and other Unions concerned were received by Sir David Shackleton, who, after hearing statements, said he would communicate with the employers. The Executive of the E.T.U. was to meet in London yesterday.

If the lock-out is consummated, about a million workers will probably be thrown out of employment by the stoppage of electrical plant.

The E.P.E.A., according to the *Daily Herald*, anticipates the extension of the trouble to electricity supply stations, and urges both parties to accept arbitration. If either refuses to do so, the Association, if involved, intends to throw its weight into the scale against that party.

Siam's Trade.—The King of Siam has formed a Ministry of Commerce for the purpose of facilitating the expansion of the country's trade. The two advisers to the Ministry are British.

Electrical Goods in South Africa.—In its comments on the market for electrical goods the *S.A. Mining and Engineering Journal* for August 7th states:—Business in the electrical wares section is rather quiet in the absence of any outstanding building operations in town or country. Prices remain about stationary, but the tendency is towards lower levels. Ceiling roses, adapters, and sundry other lines, which were heretofore in demand and practically unobtainable, are now on hand, and, if one excepts pear pushes and rosettes for bell-work, one may say generally the electrical goods market is now well supplied. Town business is rather on the quiet side, but fairly large orders are coming from outside, particularly at the present moment, from the Free State, which is now installing its municipal electric plant. Vereeniging is also ordering pretty freely.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, August 31st:—Electrolytic bars, £117, £1 increase; electrolytic sheets, no change; electrolytic wire rods, £133, £1 increase; do. H.C. wire, 1s. 4½d., ½d. increase; silicium bronze wire, 2s., ½d. increase.

Messrs. James & Shakespeare report:—Copper bars (best selected), sheets, and rods, no change; English pig-lead, no change.

British Insulated Cable Dispute.—The recent strike at the Prescot works of the British Insulated and Helsby Cables, Ltd., was settled by the company paying or agreeing to pay the employés in the cable-making departments, the last award of 6s. to the engineering trade. It was at the request of the Workers' Union secretary that the company agreed to treat the cable-makers as coming under the engineering employés' award. Now the Workers' Union comes along with a demand that the award made by the Joint Industrial Council for the cable-making industry on August 18th, should be applied to those of the workers who are employed on cable-making operations. This demand is regarded by the company as a distinct breach of faith, and it has declined to meet the demand. It is feared that another strike may take place.

The Miners' Threat to Strike.—During the week the results of the miners' ballot have been published, from which it appears that, on the whole, there is a majority of 3 to 1 in support of the leaders—we doubt whether it could be said to be in support of the proposal to strike—but in Yorkshire there is but a small majority, and in Notts. and Derbyshire the minority is very strong. On Tuesday the railway and transport branches of the "triple alliance" held a conference with the miners to discuss the situation. Apart from the miners, other Unions show no desire to bring industry to a standstill, and, doubtless, every effort will be made to avert a national disaster.

At the conference on Tuesday, the Triple Alliance resolved that the miners' claims were reasonable and just, and should be conceded forthwith. It does not follow, however, that the Alliance will support the strike; allowance must be made for tactical manœuvres. The conference was to meet again on Wednesday.

The official figures for the miners' ballot, declared on Tuesday, were:—For a strike, 606,782; against, 238,865; majority for a strike, 367,917.

The necessary two-thirds majority has, therefore, been obtained, but only by 43,000, and as boys under 18, who number 14 per cent. of the total, no doubt voted unanimously for a stoppage of work, it is clear that if their votes were excluded, there would be a shortage of some 60,000.

In view of the short stocks of coal in hand, which would be urgently required on restarting work, many manufacturers have decided to close their works in the event of a strike being declared.

While the number of workers at collieries has increased from 1,110,000 in 1913 to 1,205,000 in 1920, the annual output has fallen from 287,500,000 to 240,500,000 tons. The average annual earnings have risen from £82 to £220, and the miner works, on the average, 4·9 days per week. Since 1915 the output per man has fallen, with each increase of wages, progressively to 77·4 per cent. of its value in 1915; the seven-hour day introduced in 1919, which the miners' leaders said would lead to increased production, had the contrary effect.

Annual Outing.—On Saturday, August 21st, Messrs Robson & Coleman, of Newcastle-upon-Tyne, held their annual excursion at Ryton Willows. The party totalled 100, including staff, and employés with their wives, and an enjoyable day was spent. During the afternoon a football match was energetically decided and sports were held, prizes for which were kindly provided by Mr. R. E. Robson.

The employés of the Hart Accumulator Co., Ltd., electrical accumulator manufacturers of Stratford, London, held their 23rd annual outing on August 21st on the river, the well-appointed steam launch *England* being chartered for the return journey from Richmond to Chertsey. Fine weather prevailed, and the party, which numbered 120, had an enjoyable day. A presentation was made to Mr. E. J. Clark, late managing director of the company, as a mark of appreciation and esteem for the 22 years he had held his position; it took the form of an English lever gold hunter watch, suitably inscribed. Mr. F. J. Holmes, M.I.E.E., manager, made the presentation to his late chief, and in a few well-chosen words eulogised the work which Mr. Clark had done for the company. Mr. Clark briefly replied. During the day, the hard-working Cook's orchestra added greatly to the enjoyment of the party with numerous selections of music. The thanks of all concerned were accorded to the committee which arranged the details, especially Mr. E. Thompson, who acted in the capacity of hon. secretary.

Lead.—Messrs. James Forster & Co. report that the closing prices on August 27th were at £36 for all positions, practically the same as the previous week. Transactions approximated 3,500 tons. Total sales to America for the week ending August 20th were 4,500 tons. Last week there was continued buying, but not on so large a scale.

Messrs. G. Cawson & Co. say there is plenty of lead available, both prompt and forward, and as the Australian strike now appears to be practically settled, supplies are likely to increase. There is no improvement in the general trade demand, and electrical consumers hold aloof from the market, fearing Labour troubles, and, no doubt, anticipating lower prices.

N.F.E.A. and E.T.U.—At a meeting with the Liverpool Electrical Trades Union, which is asking for an advance of wages (the present rate is 2s. 3d. per hour), the local employers in the N.F.E.A. stated that they were not in a position to discuss wages at all, as they had been agreed upon by both executives nationally.

For Sale.—By direction of the Disposal Board, Ministry of Munitions, Messrs. G. F. Dixon & Co. will sell by auction on September 21st and following days at H.M. Factory, Letherland, near Liverpool, the modern chemical plant and new spare parts, including many electrical items. Full particulars are given in our advertisement pages to-day.

National X-Ray Reflector Co.—Messrs. the British Thomson-Houston Co., Ltd., wish us to state that they are the sole agents in this country for the above American company.

General Strike in Stuttgart.—A general strike was declared at Stuttgart on August 28th, in connection with the lock-out at the Daimler and Bosch motor works. The cause of the dispute is the 10 per cent. deduction from the wages of all workers as income tax, which was recently prescribed by law.—*Reuter's Trade Service* (Berlin).

The Overtime Embargo.—The National Executive of the Amalgamated Engineering Union ordered the embargo on overtime on maintenance jobs, set up by the Lancashire members, to be withdrawn, but the men have refused to comply. The ban on overtime in productive work remains in force.

The Manchester District Committee of the Amalgamated Engineering Union has resigned *en bloc*, and the men support its action against the order of the executive. According to the *Daily Dispatch*, men who disobeyed the Committee's order not to work overtime (unless paid an advance of 9d. an hour), were fined by the Committee, but men discharged for refusing to work overtime were deprived of the contingent and federation benefit by the National Executive.

LIGHTING AND POWER NOTES.

Australia.—New Sydney Station.—Opinion in Sydney is still divided as to the more economical position for the proposed new power station. The question is whether it will be better to build it at the coal mine to be purchased by the State, or nearer the centre of the area to be supplied. While the coal can be mined at a very cheap rate, it is thought that the cost of the extra plant required, and the necessity for long transmission lines, will more than counterbalance any economy effected in the fuel supply. Some of the coal is of very low calorific value, and as freight rates are high, many authorities consider that transport costs for the 60 or 100 miles from the mine to the city are prohibitive.

Supply Restrictions.—The manager of the Sydney Electricity Department states that the restriction imposed upon the use of radiators during certain hours of the day, has resulted in a drop of 2,000 kw. in the daily load. A 12,000-kw. alternator has now come to hand, but the arrival of another 8,000-kw. set has been delayed.

Bedwas and Machen.—Provisional Order.—The Urban District Council is making application to the Electricity Commissioners for a provisional order for the supply of electricity within its district.

British Columbia.—Hydro-Electric Plant.—Completion of the Bridge River power plant, which calls for an expenditure of $30,000,000, will mark an era in manufacturing and industrial development in British Columbia. Work has just been begun on the project. The plans contemplate a tunnel a mile-and-a-half long through Mission Mountain, through which Bridge River will discharge into Seaton Lake, six miles from Lillooet. The fall will be 1,400 ft., and 400,000 h.p., it is estimated, will be developed. Much of this power will be distributed to cities at a distance. The plant, it is said, will make Vancouver and Victoria the most important manufacturing centres on the Pacific Coast. Engineers declare the Bridge River site has enormous possibilities of power development.—*Reuter's Trade Service* (Lillooet, B.C.).

Bury St. Edmunds.—Extensions.—The *East Anglian Daily Times* says:—With reference to the application of the Town Council for sanction to the borrowing of £12,536 for electricity purposes, the borough electrical engineer reported that at the request of the Electricity Commission he attended the office at Whitehall for the purpose of giving information on the subject. Comment was made regarding the irregularity of proceeding with work before sanction to borrow the money required had been given, and he (the engineer) laid special emphasis upon the fact that it was imperative to secure the generating set and boiler without delay, otherwise the opportunity of purchasing them might have been lost, having regard to the circumstances involved. The danger of working the plant without an adequate stand-by margin was also strongly commented upon by Col. Ekin (a Government inspector), and warning given of the risk incurred thereby. The importance of installing a condensing plant to meet the full requirements of the works was urged. Severe criticism of the charges for energy, particularly for lighting purposes, was made by Col. Ekin, who considered them totally inadequate, having regard to the increased price of coal, wages, and all other materials pertaining to the cost of production, and early adjustment to enable the department to become self-supporting was urged. On the same afternoon he had an interview with an official from the office of the Ministry of Transport regarding the application that had been made for permission to increase the maximum price to 10d. per unit, and he advised that a fresh application be made to increase the maximum price according to the requirements of the department, and he (the engineer) suggested that steps be taken to increase the maximum price to 1s. per unit. The Committee decided to make an application to the Electricity Commission for the issue of a further order authorising the maximum price for electricity being raised to 1s. per unit.

Colne.—Electricity District.—Councillor Thompson, chairman of Colne Electricity Committee, reported on August 26th that Colne was one of the North-East Lancashire towns which opposed the suggested central station at Preston. They were a long way from Preston, and they comprised a large centre where electricity was supplied and would have to be brought. Electricity could be more efficiently distributed by having a station nearer. A big population was covered by Burnley, Accrington, Nelson, Colne, Rawtenstall and Bacup.

Continental.—France.—A company has been formed at Paris (58, Rue du Rocher), the Société Anonyme Gaz et Electricité de la Ville de Laon, with the object of acquiring and working concessions for lighting, heating, and motive power by gas or electricity, and more particularly concessions for lighting the city of Laon and its outskirts, and the Commune of Bruyères-et-Montbéraut. The capital is 1,000,000 fr.

There has been formed at Paris (93, Avenue Ledru Rollin), the Electrique de Saint Julien du Sault, a company whose object is the generation and distribution of electricity, more especially in the Communes of St. Julien du Sault, Villevallier, Cézy, Thèmes, St. Aubin-sur-Yonne, Villicien, Béon la Fontaine, and La Celle St. Cyr, and elsewhere, where concessions are obtainable. The capital of the company is 180,000 fr.

Italy.—The encouragement and assistance given by the Italian Government to schemes for the development of the country's water power is dealt with by a correspondent in a recent issue of *The Times Engineering Supplement*. The estimated available power is 54·75 h.p. per sq. mile, being second in Europe to Switzerland with 125·2 h.p. per sq. mile. The conditions under which concessions are granted include the sale of all developments at cost price to the State upon the expiration of a period of 50 years. Substantial financial assistance is freely given under satisfactory guarantees, and 15-year subsidies of 40 lire per nominal h.p. are granted free of tax. Subsidies are also paid to the erectors of new transmission lines for pressures above 2,000 volts. The amount is calculated upon the weight of copper employed, and ranges from 0·15 to 0·25 lire per kg. Special grants are made to individuals and companies on account of power used exclusively for agricultural purposes; this amount is generally 0·03 lire per kw.-hour, payable for a period not exceeding 10 years. Owners of hydro-electric plant in receipt of State subsidies are required to reserve a proportion of their output for agricultural purposes.

Cullompton.—Overhead Transmission.—The Electric Light Co. has applied to the Devon County Council for permission to erect overhead lines for the supply of electricity to the town.

Galway.—Public Lighting.—Complaint was made at the Urban Council of the absence of public electric lighting for some time, and it was explained that it had been agreed that there should be no lighting during the summer months. Some members thought lighting should have been resumed in August. A suggestion was adopted that a main should be provided for the lighting of the town alone, so that street lights could be extinguished, if necessary, at 1 a.m.; meanwhile the Electric Co. was asked to have full lighting resumed.

Lurgan.—Electric Lighting Scheme.—At a special meeting of the Urban District Council last week, Mr. R. Levin, chairman, presiding, the question of an electric lighting scheme for the town was considered. The scheme which had been submitted by Mr. Pleasance, Belfast, would cost about £20,000, and would include the conversion of the pumping station at Castor Bay, Lough Neagh, from steam to electric power. It was finally decided to submit the scheme to the Local Government Board, and ask for a loan to carry out the work.

Kendal.—Loan.—The Town Council has applied for a loan of £7,469 for electricity purposes, which includes £6,464 for a Diesel set.

Leeds.—Extensions.—The Electricity Commissioners have sanctioned large extensions of the electricity works, at an estimated cost of £450,000, the money to be borrowed in instalments as required.

Llandudno.—Supply Difficulties.—The electrical engineer reported to the Council that one of the generating sets had broken down and would take some months to repair. In the meantime, the available plant was greatly overloaded and there was no stand-by in case of further breakdowns. The excessive load was mainly due to the increased demands for traction supplies, which were being sold at a loss to the Council. A motion to terminate the contract with the Llandudno and Colwyn Bay Electric Railway Co. was referred back after some discussion for consideration in committee.

Manchester.—Proposed Extension.—The City Council has had under consideration proposed extensions to the Barton electric power station at an estimated cost of £700,000.

Mynyddeslwyn.—Provisional Order.—The Urban District Council is applying to the Electricity Commissioners for powers to provide and distribute electrical energy within its district.

Newhaven.—Public Lighting.—As the London, Brighton, and South-Coast Railway Co. is unable to supply electricity for the public lamps, the Urban District Council has approached the Brighton Town Council about a supply.

Oldham.—Additional Loan.—The Electricity Commissioners have pointed out that the total of the tenders accepted by the Corporation in connection with the electrical extensions is a great deal in excess of the amount put forward for sanction. The Town Clerk has accordingly been instructed to apply for permission to borrow a further amount of £22,578.

Oswaldtwistle.—Electricity Supply.—The Council has decided to apply for an order from the Electricity Commissioners authorising it to obtain a supply of energy in bulk from a neighbouring authority.

Perth.—Year's Working.—The electricity department of the Town Council, after paying off the sinking fund and interest on temporary loans, shows a profit of £2,129 on the year's working. A sum of £2,000 is allotted to the reserve fund.

Skegness.—Electricity Supply.—The report of Mr. C. H. Wordingham on the question of a public supply of electricity for the district at an estimated cost of about £44,000, has been considered by the Gas Committee, which has referred it to the Council for consideration at its next meeting.

Southport.—Year's Working.—The electricity department accounts show that the gross profit for the year was £18,819, and the net profit £3,197. The total increase in expenditure was £6,690. The report refers to the great difficulties experienced in obtaining supplies of materials.—*Liverpool Daily Courier.*

Stalybridge.—Electricity Area.—The future supply of the district has brought about opposition between the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Joint Board and the Electricity Commissioners. The Commissioners have suggested that the area for the supply of electricity should take in Stalybridge, Hyde, and Dukinfield, but should not include Mossley, and, on the other hand, from statements made at the Joint Board's meetings some time ago, it would appear that it was desirous of being linked up with Ashton and other neighbouring authorities like Oldham, Rochdale, and Manchester. The Joint Board points out that the Stalybridge, Hyde, and Dukinfield area is, for the most part, a rural one, which would require miles of cabling and tramways to link together, with the danger of its being years after such linking before it began to yield any profit, whereas the Joint Board, after being a tax on the ratepayers of the four towns since its inception, is just beginning to become self-supporting. Under these circumstances, the Joint Board is opposed to the Commissioners' proposals, and is asking for the support of the respective Corporations in the matter.

St. Helens.—Extensions.—Following a conference with a representative of the Electricity Commission, together with representatives of neighbouring electrical undertakings, the Electricity Committee of the Corporation reports that the Electricity Commission has informally consented to the extension of the boiler plant at the power station, in order to meet the increased load, at an estimated cost of £40,000, as follows:—Two additional boilers, 9,273 sq. ft. heating surface, with stokers and coal-handling plant, of an approximate steaming capacity of 35,000 lb. per hour each; one additional cooling tower of 250,000 gallons per hour capacity; an additional chimney; a new power house, and an additional water-softening plant. The electrical engineer has been authorised to obtain tenders for the necessary plant, with the exception of the additional chimney. The space now occupied by the destructor is to be taken up for the installation of the new boiler plant, and the Health Committee has decided to remove the destructor to another site.

Wallasey.—Economical Generation.—The Wallasey Electricity Committee claims that it is generating electricity at less cost than anywhere else in the Mersey-side area. The chairman of the Committee (Mr. Bellis) told the Town Council that through building a new generating station they had effected so great an economy that, while last year they generated 4,500,000 units more than in 1914, the fuel consumed was 7,000 tons less. They had contributed £24,000 to rate aid during the past six years.

Waterford.—Electric Lighting.—The Public Lighting Committee again considered the electric lighting scheme, which will be undertaken immediately, with a view to the installation being available for the winter months.

U.S.A.—New Power Plant.—The Oil Belt Power Co. is building a large electric power plant near Eastland, Texas, at a cost of $5,000,000, to supply power for oil-well pumping and the oil-field industry.—*Reuter's Trade Service* (Eastland, Texas).

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—Year's Working.—There was a loss on the tramway undertaking for the past year of £5,203. In the preceding year there was a net profit of £6,823.

Barrow-in-Furness.—Purchase of Cars.—The Tramways Committee, to meet the need of more tramcars for the public service, is buying second-hand cars from various places. Four have just arrived from Southport, and the Committee has obtained an option on six single-deck cars belonging to the Sheffield Corporation. Twelve new cars are on order, and are expected to be delivered in July or August next year.

Fare Concessions.—The Tramways Committee has recommended the issuing of certificates entitling all *bonâ fide* manual workmen to ride on the cars at workmen's rates. Those workmen having irregular hours for their meals are not to be placed at any disadvantage. The certificates, it is understood, will be issued by the men's Unions. The proposal is to be discussed before the full Council at the next meeting on September 6th.

Blackpool.—Fire in Car.—Through the fusing of a wire in the control box, the woodwork of a tramcar on the Promenade took fire, last week. As alarmed passengers made a hurried exit, the glass at the side of the car was broken. All escaped serious injury, although one or two complained of shock and bruises.

Bolton.—Year's Working.—The recently published abstract of accounts for the year ended March 31st last shows a total income from all sources of £244,172. The total of working expense was £157,335, leaving a gross profit of £86,837. After the payment of loan interest, &c., £29,811 was set apart for renewals, £15,500 for rate relief, and a balance of £2,659 carried forward to the next account, as compared with £534 in the previous year.

Burnley.—Sunday Services.—The Tramways Committee met on Thursday last to consider the situation through the ban placed on overtime by fitters employed at the tramway depôt, resulting in the service being suspended on Sundays. The difficulty was overcome, and last Sunday there was the usual service of cars.

Canada.—Railway Electrification.—The shortage of both fuel oil and of coal in certain parts of Canada has brought the question of the electrification of railways to the front, and it is now reported that the Canadian Pacific Railway Co. has taken steps to electrify its British Columbia lines.

The Bonnington Falls plant of the West Kootenay Power and Light Co. will be used to operate the railway between Kootenay Lake and Similkameen, and it is possible that a transmission line may be run up the Arrow Lakes to the main line. The company has definitely decided to install hydro-electric plants at the Donald Canyon on the Columbia River, four miles below Donald, and at Surprise Rapids on the same stream, 25 miles downwards from its junction with the Beaver River, where there is a fall of 112 ft., and ample storage accommodation in the low-lying country to the southward.

This is the first development of steam-railway electrification in British Columbia, and it is likely to be followed by similar works at Death Rapids, on the Columbia River; at Adams River on Shuswap Lake; and on the Thompson and Fraser Rivers, which would afford ample power for the electrification of the entire main-line system in British Columbia.—*Times Trade Supplement.*

Cardiff.—Return to Work.—The tramway services were resumed on Friday, last week, as the result of the decision of the municipal employés to return to work. Casual labourers accept 1s. 9d. per hour, while other workers have agreed to arbitration.

Colne.—Loan Sanctioned.—At a meeting of the Town Council, on August 26th, the town clerk reported the receipt of sanction to borrow £10,345 for the erection of a new tramway depôt.

Continental.—Sweden.—It is reported that the Swedish State Railways have recently concluded a contract with the Mota'a Lindholmens works for the delivery of 11 electric locomotives intended for use on the line between Gellivare and Luleaa. The price fixed is Kr. 725,000 for each locomotive.—*Reuter's Trade Service* (Stockholm).

France.—The Chamber of Commerce of Boulogne has been authorised to raise a loan of 3,500,000 fr. for the building of an underground railway linking the Loubet docks with the Fer du Nord Railway. This scheme has been hung up since 1913.

Doncaster.—Threatened Strike.—The Corporation tramway employés have theatened to strike during the race week—which includes the famous St. Leger—unless they are granted a further advance of 2s. per week in wages, being discontented with the advance made to them under the National Award. As a matter of fact, although Doncaster was graded "C," the Tramways Committee, taking into consideration its application for power to increase fares, decided to pay the grade "B" advance of 8s., an increase of a 1s. on the rate it was required to pay under the award. The tramways are at present being run at a loss of about £1,000 per month, the increase of fares not having yet received sanction. The Committee contends that it cannot afford to make a further increase, and that the threat of the employés is a breach of the award as well as an act of ingratitude. The receipts last year in race week were £3,298, an increase of £2,116 on those of the 1914 race week, and the loss of this income would mean that it would have to be made up out of the rates. Doncaster tramway workers are at present receiving two guineas per week more than before the war, and their hours have been reduced from 54 to 48 per week. They refuse to work overtime, or to allow the Committee to employ auxiliary labour during race week.

Dublin.—Tramway Fares.—The Pembroke (Co. Dublin) Urban Council has decided to oppose the application of the Dublin United (Electric) Tramways Co. to the Ministry of Transport for powers to increase the city boundaries and termini fares by 50 per cent., and to create new stations involving increases. Mr. C. R. Dunbar said the English and Scottish companies had got powers to increase fares, and he believed the Dublin Co. would get the same powers. He was surprised that the company had carried on so well. Sir Gabriel Stokes remarked that it would cost the tramway company practically nothing to give the Pembroke area certain advantages in respect of the service. Thus, before the war they had a 4 minutes' service to Donnybrook; now it was a 6½ minutes' service. One branch, that at Kenilworth Road, was virtually useless as it was run at present. He pointed out that it

was proposed to charge 3d. from Donnybrook to Nelson's Pillar, in the heart of the city, a distance of 2 miles 6 furlongs, whereas the fare from Clonskeagh to the Pillar was 2d., a distance of 2 miles 7 furlongs.

Liverpool.—Derailment.—The derailment of a shunting engine and two wagons on the Lancashire and Yorkshire Liverpool-Southport line caused a complete block of the electric lines on the west side of Sandhills. Inward trains to Liverpool had to disembark their passengers at the station before Sandhills until the lines were cleared.

London.—"Underground" Improvements.—Writing in the *Evening News*, Lord Ashfield outlines some improvements to be effected by the Underground companies when fares are raised to a level which will enable the work to be carried out. The City and South London Railway—the first of the "tubes"—is to be enlarged to the present standard tunnel gauge of 11 ft. 8½ in. in place of the existing gauge of 10 ft. 2 in. The platforms at stations are to be lengthened. At present only five cars at a time can be accomodated at each station, and the extensions will enable seven cars to to be drawn up at the platforms. The Bakerloo section of the London Electric Railway is also to be improved, and a surface railway will be constructed from Golders Green to Hendon.

Fares.—The *Daily Telegraph*, in the report of an interview with Mr. Arthur Neal, M.P., Parliamentary Secretary to the Minister of Transport, says that the main points of difference between the L.C.C. and the Underground Companies on the question of fares are :—

1. The amount of the initial fare to be charged at certain stages of the journey : The Underground Co. proposes that there should be a minimum initial fare of 1½d. The County Council, on the other hand, was of opinion that it would be advisable to retain a penny minimum fare in certain circumstances, and Lord Ashfield indicates his willingness to endeavour to meet the wishes of the County Council as regards omnibus fares.

2. Stage Points : Agreement has not yet been arrived at between the Underground Co. and the County Council as to the points between which the new fares should apply, but it is admitted there are many clearly defined points, and no difficulty is anticipated in arriving at an agreement.

3. Cheap Mid-day Fares : The County Council proposes that cheap mid-day fares on the basis of 2d. for length of journey should be retained, and, further, that during mid-day passengers be allowed to travel over any ordinary 2d. stage for 1d. The Underground Co. strongly dissents from this suggestion, and feels that the introduction of fares of this description is wrong in principle. It was understood from Mr. Hume that, provided satisfactory arrangements were come to on Points 1 and 2, he would use his best endeavours to arrive at an agreement with Lord Ashfield on this point.

New Workmen's Fares.—The new workmen's fares came into operation on Wednesday last, and the North London railway was one of the first lines to announce the new rates. Under the scale abolished it was possible to travel from and between Broad Street and Poplar or Camden Town in any direction for 2d. The one-price ticket has been abolished and a varying table of fares brought into operation.

The fare from Broad Street to Poplar in each direction will be 6d., and to Camden Town 6d. In the case of intermediate stations the fares are also considerably higher. A ticket from Hackney to Broad Street will cost 4½d., and from Hackney to Poplar or Camden Town 6d.—*Financial Times*.

Extension of Time.—The Minister of Transport has extended the time of the London Electric Railway Act, 1913, for the construction of works, &c., until August, 1921.

Nottingham.—Free Travel.—The Tramways Committee has decided to continue the privilege of free travelling granted to disabled ex-Service men for a further 12 months, until the end of July, 1921.

Pontypridd.—Strike.—Owing to a strike, the whole of the Council's tramway system is shut down. The trouble is stated to be due to the failure of the Council to settle a wage question.

Rothwell.—Time Extension.—The period in which the Tramways Co. is to complete its services has been extended to July 31st, 1923.

Southport.—Year's Working.—The annual report of the Corporation tramway department states that the gross profit for the year was £21,707, against £20,347 for the previous year. The sum of £2,100 was applied in aid of rates, and after various other items had been met, including interest and sinking fund, a balance of £819 was left to be applied in reduction of the previous deficit.—*Liverpool Daily Courier*.

U.S.A.—Brooklyn Strike.—The whole of the Brooklyn (New York) tramways, tubes and elevated railways were suddenly shut down on August 29th by a strike of employés. The latter demand recognition of their Union and arbitration on wages questions.

Keighley.—Railless Car Mishap.—While the only double-decker railless car on the Utley-Eastburn route was being placed in its depôt at the Utley terminus on August 27th, it began to move rapidly down an incline immediately the driver had detached the overhead running gear. The conductor had left the car to open the doors, and the driver, at considerable risk, managed to get to his seat, but was unable to reach the brake gear in time to stop the car. It ran over the road embankment, which has a five or six yards slope, but remained upright. The driver was thrown from the car, but escaped with a severe shaking and minor bruises. The front wheels of the car were broken off. This car is believed to be the only railless double-deck one in use in this country; it is of Viennese make.

TELEGRAPH AND TELEPHONE NOTES.

Continental.—Telegraph Rates.—The Postmaster-General gives notice that by agreement with the Governments concerned the rates for telegrams to Belgium, France and Holland was increased on and from September 1st from 2d. to 2½d. a word, and that to Algeria and Tunis from 2½d. to 3d. a word. The rates from these countries to the United Kingdom were correspondingly increased.

New Telephone Exchanges.—A number of subscribers in the area served by the Mayfair telephone exchange have received notice that they will be transferred, in three or four months' time, to Langham, a relief exchange which is being erected. The new exchange will be at first limited to about 2,000 subscribers, and will begin at the number 1,000, as it is hoped to make this exchange automatic, similar to those in operation at Epsom, Leeds, and Derby, says *The Times*. An automatic service is promised in the City some time next year. A new City exchange, the "Gower," is in course of erection. A trunk "no delay" service, serving places within 25 miles of London, is also being put through as speedily as possible. The Mayfair exchange is the second largest of the five great London exchanges; it serves from 5,000 to 6,000 subscribers. Its capacity has been full for some time. As far as possible, subscribers will be given numbers corresponding to their former Mayfair ones, but, where this is not possible, they will be given quite different numbers, so as to avoid confusion.

United States.—A working agreement has been entered into between the American Telephone and Telegraph Co. and the General Electric Co., of the U.S.A., whereby both obtain the mutual use of all patents and scientific secrets. The G.E. Co. is already associated with the Radio Corporation of America, and Mr. H. B. Thayer, president of the General Electric Co., says, with reference to the new agreement :—

"The world system of the wireless universal service and the Bell system are thus brought into a harmonious relation that will facilitate the public use of linked-up wireless and telephone servi es. The service will be extended to ships at sea and to Europe and foreign countries."

The arrangement also makes it possible, according to Mr. Thayer, for several conversations to take place on the same wire simultaneously.

Telephone Rates.—For the third time within a month, the New York Telephone Co. has petitioned the Public Service Commission for permission to increase subscribers' telephone rates. The latest request is for an increase of 33 per cent., which, if allowed, will add £3,200,000 to the annual cost of the telephone service for residents in New York city, or, on a basis of 800,000 instruments, an additional £4 to each subscriber.

Wireless on Lightships.—Re-installation.—At the beginning of the war, the wireless telegraphic installation on the Mersey Bar lightship, Liverpool, had to be dismantled, otherwise the craft, as a matter of international law, would have been liable to be torpedoed by an enemy submarine. The installation has been out of operation since, but negotiations are now in progress for the re-installation of wireless on the lightship.

Wireless Operators.—Wages Dispute Settled.—It will be remembered that the strike of wireless operators was called off at the end of June on the understanding that a satisfactory settlement of their demands should be concluded within a month. The operators originally asked for an eight-hour day, and a minimum weekly wage of £2 16s. for qualified men, rising to £7 14s. after nine years' service. Conferences were held between the Association of Wireless Telegraphists and the London and District Association of Engineering Employers, but no agreement was reached. The month's truce expired at midnight on July 23rd, the men, however, carried on pending the result of further negotiations. On Friday last week we were informed by the Marconi International Marine Co., Ltd., that the dispute had been settled.

The settlement gives the men an average increase of 156 per cent. on pre-war rates of pay; the men claimed 177 per cent. War bonus is merged in salary at the rate of £60 per annum, and the increases are retrospective to May 17th last. A risk allowance of 7½ per cent. on salary is to be paid for service on oil tankers. The new scale of payment is in three grades :—Grade 1, £22, £24, and £25 per month; grade 2, £16, £18, and £20; grade 3, £11, £12, and £14. The Marconi Co. intends to institute a higher class composed of sea-going operator inspectors at £26, £28, and £30 per month, for service in the large liners.

The question of examinations which the companies desired to institute has been waived, as has also the provision whereby shore allowance of 3s. 6d. a day was not payable until seven days after arrival in port, and this allowance will now be paid from the day

after signing off articles until the day before re-engagement. The "in-charge" allowance of 5s. a week, payable during the first three years of service when men are in charge of a ship's station, will be continued. The baggage allowance of 7s. 6d. has been increased to 10s. For foreign service allowance, instead of a fixed sum per week, the National Maritime Board Regulations governing salaries, plus a percentage for that service, will be instituted in future.

Annual leave of two weeks on salary without shore allowance will be given. Sick leave has been reduced from eight weeks in any consecutive 12 months on full pay to 14 days on half the actual salary, less the amount received from the National Health Society. The agreement was signed by the London and District Association of Engineering Employers, the Marconi Co., and the Association of Wireless Telegraphists as from August 26th.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW, *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes. Specifications, &c., will be available at Australia House, Strand, W.C.—*Reuter's Trade Service* (Brisbane).

BRISBANE.—December 9th. Department of Public Works. Seventy three-phase oil-cooled core type static transformers—15, 20, 25, 30, 35, 40 and 50 K.V.A. capacity, 6,600/440 volts.—*Reuter's Trade Service.*

BRISBANE.—January 20th, 1921, and February 25th, 1921. The City Electric Light. Co. A 10,000-KW. turbo-alternator set; transformers and switchgear.—*Reuter's Trade Service.*

VICTORIA.—October 20th. Victorian State Rivers and Water Supply Commission. Two 1,600-B.H.P. steam turbines, with mechanical reduction gearing and condensing plant.—*Reuter's Trade Service* (Melbourne).

MELBOURNE.—September 23rd. Melbourne and Metropolitan Tramways Board. Supply, delivery and erection of two 350-H.P., A.C. motors, also switchgear. (Contract No. 101.) Particulars from the offices of the Board in Melbourne.—*Reuter's Trade Service.*

Bolton.—September 16th. Electricity Department. One 12,000-KW. turbo-alternator. (August 20.)

Bradford. — September 9th. Electricity Committee. Contract R. 159. No. 4 boiler house and equipment, including buildings, water-tube boilers, economisers, induced-draught plant, feed pumps, coal-handling plant and piping systems. (August 6th.)

Bridlington. — September 5th. Electric light installation at Corporation's Sanatorium, on Henley's system of wiring. Particulars from A. J. Beckett, Electricity Works.

Croydon. — September 8th. Tramways Department. Supply and installation of a new feeder cable. (August 13th.)

Edinburgh.—September 6th. Electricity Department. Converting plant for Portobello generating station and sub-station. Specification No. 26. (August 6th.)

September 7th. Corporation. Electric lighting installation at the Public Health Offices, Johnstone Terrace. Plans at Engineer's Office, Dewar Place.

September 27th. Electricity Supply Department. Coal, ash and flue-dust handling plant, circulating pumps and pipework. (August 27th.)

France.—The Department of Overseas Trade informs us that the Chamber of Commerce of La Rochelle has been authorised to raise a loan of 2,100,000 francs for the purpose of effecting certain improvements at the port of La Pallice, including the acquisition of eight electric cranes, and the construction of electric tracks for the same, and the enlargement of the electric sub-station.

India. — AGRA. — October 22nd. Municipal Board. Complete generating plant, comprising: four Diesel engines and H.T. alternators; H.T. and L.T. switchgear, transformers and sub-station equipment; 15 miles underground H.T. cables, 28 miles overhead L.T. three-phase mains and street lighting equipment, complete with all accessories. (August 20th.)

Langho (near Blackburn).—September 15th. Manchester Board of Guardians. Replating a battery of accumulators (98 cells), at the Epileptic Colony, for the Manchester Union. Further particulars from Medical Superintendent at the Colony.

Lithuania.—The Department of Overseas Trade last week-end was asked to telegraph quotations to H.M. Commissioner in the Baltic States, for one hundred and fifty miles of good light field telephone wire.

London.—ST. PANCRAS.—September 14th. Electricity Department. Two water-tube boilers, each of 40,000 lb. per hour evaporation capacity. (August 27th.)

WESTMINSTER.—September 15th. Board of Guardians. Supplies of electric lamps, fittings, &c. Mr. W. J. Lickley, Clerk to the Guardians, Princes Row, Buckingham Palace Road, S.W. 1.

Macclesfield. — September 13th. Cheshire County Asylum. Supply of electrical goods. Mr. W. F. Tingay, Parkside Asylum.

Manchester.—September 14th. Tramway Committee. Steel girders, tramway rails, permanent-way special track work. Mr. J. M. McElroy, General Manager, 55, Piccadilly, Manchester.

September 20th. Electricity Committee. Six 33,000-volt, 19,500-K.V.A., 3-phase static transformers, house service and testing transformers. (August 6th.)

Merthyr Tydfil.—September 6th. Electrical fittings for six months for the Board of Guardians. Mr. F. T. James, Clerk, High Street.

New Zealand.—INVERCARGILL.—October 19th. Borough Council. 10,600 lineal yards of 80-lb. grooved girder steel rails in 40 ft. lengths; 3 miles of copper trolley wire; 1¼ miles of stranded copper feeder cable with weather-proof insulation. Particulars from Chief Electrical Engineer.—*Reuter's Trade Service.*

Nuneaton.—September 20th. Electricity Department. H.T. and L.T. switchgear, connecting cables and accessories. (August 13th.)

Rothwell.—YORKS.—September 8th. Urban District Council. Internal electric wiring of 54 houses for Urban District Council. Particulars from the Clerk.

South Africa.—JOHANNESBURG.—September 6th. Gas and Electric Supply Department. Class A. One or more light electric passenger vehicles. Class B. One or more light electric delivery vehicles. (August 13th.)

Stockton-on-Tees.—August 30th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (August 13th.)

Uganda.—February 19th, 1921. Government of the Uganda Protectorate. Tenders invited for a concession of a portion of the Ripon Falls of the Nile. (See this column in our issue of July 30th.)

Walthamstow.—September 8th. Urban District Council Electricity Department. Two water-tube boilers and economisers; one 5,000-KW. turbo-alternator and condensing plant; one 1,500-KW. and one 1,000-KW. rotary or motor converters; one natural-draught cooling tower; E.H.T. and L.T. switchgear; E.H.T. cables. (August 13th.)

Warrington.—September 7th. Electricity and Tramways Committee. Surface condensing plant. (August 6th.)

West Ham.—September 9th. Board of Guardians. Electrical fittings for six months. Mr. T. Smith, Clerk to the Guardians, Union Road, Leytonstone, E. 11.

CLOSED.

Hoddesdon.—Urban Council:
New Destructor Co., Ltd., repairs to dust destructor, £222.

FORTHCOMING EVENTS.

Institute of Metals.—September 15th and 16th, at Barrow-in-Furness. Autumn Meeting.

Machine Tools & Engineering Exhibition at Olympia.—September 4th to September 25th.

Municipal Tramways Association.—At Cardiff, September 15th to 17th. Annual Conference.

Institution of Mining Engineers.—Wednesday, September 15th. At the Town Hall, Manchester, at 10.30 a.m. Annual General Meeting. September 16th and 17th, visits to places of interest.

Off-peak Loads: Refrigeration.—In *le Génie Civil*, the advantages of ice-making as an off-peak load for small electricity works are detailed, a special feature of this load being the fact that it is heaviest during the summer, when the normal load is at the minimum. M. Follain, in the *Ingénieur Constructeur*, gives figures showing that with a consumption of 600 KW.-hours, 18 hours per day, during five months, an output of 25 kg. of ice per KW.-hour supplied to the refrigerating machine can be secured, or 225 tons a day. This, he shows, can be done on a commercially profitable basis.

NOTES.

Origin of the Elements.—This was the title of a paper recently presented to the Physical Society of London by Dr. J. H. Vincent, who explained that atomic weights were regarded as the weighted mean values of the atomic weights of the isotopes of the elements; but it was assumed that, as a rule, the atomic weight was near that of some one isotope. Figures and tables were drawn up showing how this accounted for the values of a large number of atomic weights, if one also assumed that the weights and positions in the periodic table of any isotope were conditioned by laws similar to those holding in the recognised radio-active families. The elements were all supposed to be derived from parent elements by processes known to occur in actively radiating families; but their radio-activity was not in general detectable by the usual means owing to the velocity of expulsion of the particles being low. The possibility of the reversibility of some radio-active processes was regarded favourably. The various difficulties in connection with the views advocated were discussed, and some suggestions for experiments were made. Finally, the theory was used to explain the so-called laws of the atomic weights of elements of low atomic weight, and the shape of the curve obtained when the atomic weights were plotted against Moseley's numbers.

Prof. A. O. Rankine explained that discovery in physics had been making very rapid strides, particularly in relation to the dimensions and constitution of atoms. There were, in addition to the remarkably copious information regarding isotopes obtained by Dr. Aston, two other equally fruitful researches, the results of which had been recently published. He referred to the connection between atomic dimensions and atomic number revealed in July by Prof. W. L. Bragg at the Royal Institution, and to Sir E. Rutherford's discovery—announced in the Bakerian lecture—of a new isotope of helium obtained by disintegrating oxygen. In such circumstances, Dr. Vincent might be regarded as rather bold in having presented his paper when he did. But the speaker felt convinced that, although the views expressed would have to be modified in details as discovery proceeded, the new discoveries were themselves most likely to point to connections between the elements on a broad basis similar to the lines indicated by Dr. Vincent. It might, indeed, turn out that the changes suggested by the author were not actually spontaneous or radio-active, but that they might be effected by the supply of energy from outside. The speaker did not see what justification there was in assuming that every element which was a mixture of isotopes was bound to have a predominant isotope which had an atomic weight equal to the integer nearest to the mean atomic weight of the mixture. There was, indeed, definite evidence that this was not always the case. In the case of bromine, the accepted atomic weight of which was 79.92, there was no isotope of weight 80, but bromine was a mixture in very nearly equal proportions of two isotopes 79 and 81. Thus there was no bromine of zero isotopy, as assumed by Dr. Vincent.

Dr. Vincent, replying, said it was purely an assumption on his part to take the predominant isotope as always existing. It was very rarely indeed that it did not fit in with the facts. He had purposely kept off the subject of end products in the meantime. There were some well-marked alphatopic series among classes 1 and 2.

Electro-deposited Thermo-Couples.—In a paper recently read before the Physical Society of London, Mr. W. Hamilton Wilson and Miss T. D. Epps gave an account of the construction of thermo-couples by means of electro-deposition. The method, which was devised to overcome the difficulty of making satisfactory soldered joints between the elements of thermopiles having a large number of closely-packed junctions, consisted of using a continuous wire of one of the elements, and coating those parts of it which had to form the other element with an electrolytic deposit of another metal. If the conductivity of the latter was considerably greater than that of the former, and a fairly thick sheath was deposited, a thermo-couple was produced which was not appreciably impaired in efficiency by the short-circuiting effect of the core. Constantan wires, coated with either copper or silver sheaths, were found to be suitable for most purposes. In the discussion that followed the reading of the paper, Mr. R. S. Whipple explained that there were many cases in which the device would be of the greatest service to physicists; for instance, in the measurement of radiation. He mentioned that Prof. Hill, of Cambridge, had recently been measuring the rise of temperature of nerves in action by means of these couples. Mr. F. E. Smith explained that the method would be a great labour-saving device, and Dr. J. S. Anderson emphasised its utility for spectro-radiation work, as the total breadth could be made very small and a large number of junctions per centimetre employed. He had used such couples, and was very pleased with them. In his reply to the discussion, Mr. W. H. Wilson said there would be no difficulty in measuring low surface-temperatures with an instrument employing these junctions. As regarded measureable temperature difference, he had not gone beyond about 1/1,000 deg. C. He had not tried Wollaston wire, but he found that a patent had recently been applied for using such wire and dissolving off the sheath from one "element." Many of the couples shown were wound on lathes. In other cases the grooves were lathe-cut and the wire put on by hand, which was almost as quick. His results appeared to be due to ordinary thermo-electric effects.

The Engineering Training Organisation.—The attendance of members of the Organisation at the meeting held at the Institution of Civil Engineers on Wednesday last, was rather unsatisfactory, as important resolutions were dealt with, affecting the future of the work carried out by the Organisation during the past three years. Sir Maurice FitzMaurice, C.M.G., who occupied the chair, said that in 1917 when the body was formed, it was not to be expected that engineering firms would be able to give much attention to the subject, as their whole efforts were required in the production of war *matériel*, but the three leading Institutions gave a subscription of £250 each, which was probably meant to be an annual subscription. The post-war response to their appeals, however, was a very small one, and as a consequence the Organisation now found itself unable to continue as a body owing to lack of funds.

Mr. C. H. Wordingham, C.B.E., said that it was through no fault of the Executive that the present unfortunate position had been reached, but circumstances beyond their control had forced them into it.

Sir William Ellis expressed his indebtedness to Mr. Wordingham for the way in which the latter had taken over the chairmanship of the Executive. The Organisation had found that its scope, as originally formulated, was not wide enough. The outcome of the work had been to compile a vast amount of statistics and information regarding the conditions of apprenticeship in this country, and their labours, therefore, had not been in vain. Sir William blamed the heavy taxation imposed upon industry for the lack of financial support. They had found that placing boys in engineering works was no simple task, as the majority of firms had long waiting lists of candidates for apprenticeship.

Mr. Wordingham then submitted four proposals to the meeting, the substance of which was as follows: That the Executive Committee should be authorised to negotiate with the Employers' Association and the Federation of British Industries, with a view to one of those bodies taking over the duties of information gathered by the Engineering Training Organisation, and that from the date of the transfer of activities to either body, the Organisation should cease to exist.

Sir W. Ellis said that the Council had kept a small balance in hand, and this would be handed over to the body agreeable to taking over the work.

Votes of thanks were then passed to Mr. Berriman, who, in reply, said much credit was due to his secretary; to Mr. Wordingham, and to the Daimler Co. for the facilities and help afforded the Organisation.

London Street Accidents.—During the year 1918-19, says the report of the Commissioner of the Metropolitan Police, 688 persons were killed, and 19,027 injured in street accidents in the London area. Before the war the yearly loss of life in London street accidents was rising; in 1913 the total killed, 596, and the lives lost by the agency of motor-omnibuses and electric tramway cars, 190 and 58 respectively, had not been reached in any previous year. The reduction in omnibus traffic during the war reflected itself in fewer accidents. In 1918 only 121 lives were lost by this agency in London, but the toll taken by the tramway cars, which carried more passengers, was reduced by one only to 58. The latest police returns show that with increasing traffic motor-driven vehicles cause more accidents. In 1919 omnibuses accounted for 136, but tramway fatalities fell to 41. A large increase appears in the number of deaths caused by "other mechanically-propelled vehicles"; in 1918 such vehicles killed 319 persons in London, and last year the number rose to 398. The total of all accidents caused by vehicles in London streets rose from 15,588 in 1918 to 19,685 in 1919. Clearly street accidents are becoming more dangerous. There was never greater need for the constant monition of "safety first," with the practical addition of more street "refuges."—*Daily Mail.*

A New Diesel Engine.—Mr. C. M. Schwab, chairman of the Bethlehem Steel Corporation (Inc.), U.S.A., announces that the company has perfected a new two-cycle internal-combustion engine, which is adaptable for ship propulsion as well as for stationary purposes, will produce the same horse-power as a four-cycle engine twice its size, and effects a saving of two-thirds of the fuel expense as compared with a steam-driven oil-fired vessel. A successful trial of the engine is reported to have been made in an ore-carrying ship. Sir Trevor Dawson, vice-chairman of Messrs. Vickers, Ltd., is reported to have said that similar results have already been accomplished by British engineers.

Appointments Vacant.—Engineering assistant (£350) for the St. Helens Corporation Electricity Department; chief assistant (£450), mains assistant (£200), four improver assistants (£2 to £3), for the City of Worcester Electricity Department; junior assistant engineer (£350) for the Corporation of Wimbledon Electricity Department; telegraph engineer (£480) for the Government of the Gold Coast; general works manager for the English Electric Co., Ltd. For particulars see our advertisement pages to-day.

The Threatened Coal Strike.—A correspondent writes :—*Leeds.*—Industrial concerns are trusting in Providence that the strike will not materialise, and coal traders say that there has been no particular rush of orders. Stagnation in the textile trade has released much coal for other industries. The city electricity department is stated to be fairly well situated, having a stock of coal sufficient to last about four weeks at ordinary working, and longer by curtailment of output and consumption of electricity.

Bradford.—Industrial concerns are not greatly worried here, because trade is slackening. Domestic supply is rather good, owing to wise stocking in advance. The electricity and gas departments are not so well placed, and neither is likely to be able to continue producing through anything like a lengthy strike. A couple of weeks is mentioned as somewhere about the limit of endurance. Special emergency stocking has been handicapped by the advent of the local general holidays.

Halifax.—The electricity and gas departments are in a position to withstand a strike for some considerable time, probably seven to eight weeks in the case of the former, and at least a month in the case of the latter, so long as there is no waste by consumers. Industrial coal stocks are low. Good quality house coal is short, though there is a fair amount of common quality. Some 3,000 tons has been stacked in various yards in anticipation of a possible winter shortage.

Doncaster.—Owing to recent restrictions in coal supply the electricity and gas departments here have been unable to stock, and if there is a strike have only about three weeks' coal supply.

Black Country.—In the event of a miners' strike, the Shropshire, Worcestershire, and Staffordshire Electric Power Co., which supplies many of the most important industries of the Black Country, would be able, with its present coal stocks, to continue full output for five weeks. It is anticipated, of course, that there would be a heavy falling off in the demand, so that the supply should suffice for two months.

Birmingham.—At the Electric Supply Department, the coal stock is sufficient for five weeks' full output, or, probably, a decreased supply for a couple of months.

Fatality.—The Manchester City Coroner (Mr. W. W. Surridge) last week returned a verdict of "Accidental death" on Walter Eckersley (19), a linesman's labourer in the employ of the L. & Y. Railway Co., who died after being badly burned through coming in contact with a "live" rail on the railway line near Prestwich Station. Another linesman testified that Eckersley thoroughly understood the "live" rail and its dangers, and said special regulations with regard to the working of the "live" rail were issued by the railway company in book form, and Eckersley had had a copy.

Inquiries.—Makers of vitreous enamel for electric light shades, and firms that do enamelling, are asked for.

Glasgow's Housing Exhibition.—Rapid preparations are being made for the Housing and Health Exhibition, which, under the auspices of the Corporation, will be officially opened at the Kelvin Hall of Industries, Glasgow, about the middle of September. So great has been the demand for space, that it has only been with difficulty that the management has been able to meet the wishes of all prospective stallholders, despite the fact that since the holding of a similar exhibition a year ago, the Kelvin Hall has been greatly extended. The display will be one of unusual importance to everyone interested in the building and allied trades. Among the exhibitors will be the following :—

Electrical Appliances, Ltd., Glasgow (electrical appliances).
Western Electric Co., Ltd., Glasgow (electrical appliances).
Falk, Stadelmann & Co., Ltd., Glasgow (electrical goods).
Electric Suction Sweeping Co., London (sweepers).
Glasgow Corporation Electricity Department (electric stoves and other domestic electrical appliances).
Allies Electric Lamp Co., London (electric lamps, &c.).
R. & A. Main, Ltd., Falkirk (gas and electric stoves, &c.).

The Exhibition will be under the direction of Mr. James M. Freer, who officiated in a similar capacity on the occasion of the last local Exhibition, when he was paid the unique compliment of a special vote of thanks from the Glasgow Corporation at the conclusion of the Exhibition.

Commercial Motor Exhibition.—A Commercial Motor Vehicle Exhibition is to be held under the auspices of the Society of Motor Manufacturers and Traders at Olympia, and will be opened on October 15th. During the week of the exhibition the Imperial Motor Transport Conference will hold a number of meetings.

Motor road transport is entering more and more into every phase of national life, nor is it likely to diminish in importance while our coal difficulties are so great. An exhibition of the latest types of chassis and the proceedings of the conference should therefore prove of exceptional interest.

Service Notes.—Lieutenant M. R. Kirby, North Riding Royal Engineers (Electric Lights Company) has resigned his commission, and retains his rank. Major A. V. White has resigned his commission in the Hants Fortress Royal Engineers (Territorial Force), in which he held field rank from June, 1916, and was associated with it from the outbreak of the war. Lieutenant E. E. Mann on retiring from the Hants Fortress Royal Engineers (Territorial Force), has been given the rank of captain, which he held temporarily during the war. The following subalterns of the same corps who were employed with the electric light companies, have resigned their commissions:—Lieutenants D. A. Bevis, G. J. McDonald, F. E. Pipe, H. W. Knapp, H. C. Holroyd, F. A. Geary, and E. H. Bond, all subalterns of 1916-17.

Birmingham Electric Club.—The Club commences its winter session on September 11th. The meetings are held on the second Saturday in each month, at the Grand Hotel, Colmore Row, at 7 o'clock. The arrangements for the first half of the session are as follows :—

September 11th.—"Some Considerations with Regard to Low-Tension Switchgear," by Mr. R. Gregory.
October 9th.—"Thermo-Electric Currents as Applied to Pyrometry," by Mr. F. S. J. Pile, M.A.
November 13th.—"Some Aspects of Modern Works Management," by Mr. H. C. Young, A.M.I.E.E.
December 11th.—Annual general meeting.

Terrestrial Magnetism.—Owing to the energy and well-laid plans of Dr. L. A. Bauer, the general magnetic survey of the earth is within sight of completion. The next step in the campaign of the Department of Terrestrial Magnetism of the Carnegie Institute at Washington, says the *Journal* of the Franklin Institute, is the promotion of additional observatories in various parts of the world. The dearth of such stations in the southern hemisphere led to a search for a suitable site in Australia. The spot finally selected is 12 miles west of Watheroo, on the Midland railway, 132 miles from Perth, where the Government of Western Australia presented 240 acres of land for the observatory. Several lines of work will eventually be conducted at the institution, but up to the present not all types of work have been provided for. Observations in terrestrial magnetism began on January 1st, 1919, and meteorological data are also obtained.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Colne Tramways Committee has recommended the appointment of MR. J. THOMPSON, electrical engineer, as manager of the tramways, in succession to Mr. Richardson. Mr. Thompson will combine the two positions, at a salary of £700 a year. This has been confirmed.

A presentation of a dressing outfit was made, on August 26th, to MR. H. AINSWORTH, assistant store- and time-keeper at Blackburn tramways shed department, Intack, who is leaving for Canada.

MR. C. BAILEY, who is leaving the Woking Electric Supply Co., Ltd., to take up duties in Bury, was presented, on Friday last, with an oak clock by the staff and employés.

MR. W. G. TURNER, A.M.I.E.E, chief assistant engineer to Newcastle and District Electric Lighting Co., Ltd., has been presented with a silver salver by the officials and staff upon the occasion of his leaving the company to take up the position of borough electrical engineer to Southampton Corporation.

MR. S. L. MARTIN has resigned the position of sales manager to Messrs. Robert Warner & Co., Ltd., as from August 27th.

Obituary.—H. L. JOLY.—We learn with regret that Mr. Henri Louis Joly, A.M.I.E.E., M.C.J.S., died on August 26th. As an active promoter of the electric vehicle, and an authority on storage batteries, Mr. Joly had accomplished valuable work in the electrical field, and he was also an expert on Japanese art, of mature and refined judgment.

F. R. BOARDMAN.—The death occurred at East Ham, on August 19th, of Mr. Frederick R. Boardman, manager of the electrical department of Messrs. Marion & Co., and the inventor of an arc lamp and the Boardman light for photographers. He was 63 years of age.

NEW COMPANIES REGISTERED.

Jenner Light & Power Co., Ltd. (169,663).—The notice under this heading in our last issue should be amended by the omission of the name of Mr. C. G. Maisey, Warlingham, Jersey Road, Osterley Park, who, we understand, has no financial or other interest in the company.

Ventock, Ltd. (169,725).—Private company. Registered August 18th. Capital, £5,000 in £1 shares. To carry on the business of electrical, mechanical, constructional, and general engineers, manufacturers and workers of electricity, electrical conduits, switchboards, and apparatus, &c. The subscribers (each with one share) are: H. Craske, 20, Veronica Road, S.W. 17, engineer; G. D. Hine, 12a, Waterloo Place, S.W. 1, surveyor. The subscribers are to appoint the first directors. Registered office: Dacre House, Victoria Street, S.W. 1.

R. Darbyshire, Ltd. (169,746).—Private company. Registered August 19th. Capital, £10,000 in £1 shares. To acquire and turn to account any lands and buildings in the U.K., U.S.A., Canada, or elsewhere, and to carry on the business of electricians, mechanical engineers, &c. The subscribers (each with one share) are: R. Darbyshire, 10, Upper Talbot Street, Blackpool, electrical engineer; W. Darbyshire, 27, Caunce Street, Blackpool, electrical engineer. The first directors are: R. Darbyshire, W. Darbyshire, and J. Hollas. Registered office: 10, Upper Talbot Street, Blackpool.

Electro-Chemical Industries, Ltd. (169,790).—Private company. Registered August 21st. Capital, £10,000 in 9,000 20 per cent. cumulative pref. shares of £1 each and 20,000 ordinary shares of 1s. each. To carry on the business indicated by the title and that of smelters and reducers of ores and minerals, &c. The subscribers (each with one preference share) are: E. Howard, 79, Boyson Road, S.E. 17, secretary; R. Radcliffe, 34, Talbot Road, Bayswater, W. 2, secretary. Directors not named. Solicitors: Lloyd, Richardson & Co., 3, Howard Street, W.C. 2. Registered office: Regent House, Regent Street, London.

S. Dagnall, Ltd. (169,775).—Private company. Registered August 20th. Capital, £5,000 in £1 shares. To acquire the business of an electrical, mechanical, and general engineer and contractor carried on by R. S. J. Dagnall, as "S. Dagnall," at 420, Stratford Road, Sparkhill, Birmingham. The first directors are: R. S. J. Dagnall, 420, Stratford Road, Sparkhill, Birmingham; S. Phillips, 394, Shaftmoor Lane, Hall Green, Birmingham. Solicitor: T. Coates, 57-8, New Street, Birmingham. Registered office: 420, Stratford Road, Sparkhill, Birmingham.

Star-Port, Ltd. (169,801).—Private company. Registered August 21st. Capital, £100,000 in £1 shares. To acquire certain patents belonging to O'Neil's Recorder Syndicate, Ltd., and relating to the navigation of ships and otherwise, and to carry on the business of mechanical, electrical, hydraulic, and general engineers and contractors, manufacturing of signalling and similar apparatus, &c. The subscribers (each with one share) are: C. A. Beldam, 57, Gracechurch Street, E.C., engineer; R. S. O'Neil, 57, Gracechurch Street, E.C., engineer. The subscribers are to appoint the first directors. Registered office: 16, Philpot Lane, E.C.

North-Eastern Welding Co., Ltd. (11,390).—Private company. Registered in Edinburgh August 21st. Capital, £10,000 in £1 shares. Fusers of metal (electrically or otherwise) for welding or repairs, metal workers and manufacturers, boiler makers, shipbuilders, shipwrights, electrical engineers, &c. The first directors are: Stewart H. Fullerton, 8, Gower Street, Ibrox, Glasgow, engineer; A. Proctor, Roman Wall House, 1, Crutched Friars, London, E.C. 3, merchant. Secretary: J. T. Simpson. Registered office: 146, Union Street, Aberdeen.

Oldfield Engineering Co., Ltd. (169,770).—Private company. Registered August 20th. Capital, £10,000 in £1 shares. To carry on the business of engineers, millwrights, manufacturers of rubber machinery, gas and oil engines, electrical and gasworks plant, &c. The subscribers (each with one share) are: J. W. J. Walker, 24, Rivington Road, Pendleton, Manchester, works director; J. Hodges, 89, Albert Avenue, Sedgeley Park, Prestwich, electrical engineer. The subscribers are to appoint the first directors. Solicitor: S. Taylor, 8, John Dalton Street, Manchester.

Advance Engineering Co., Ltd. (169,755).—Private company. Registered August 20th. Capital, £10,000 in £1 shares. To carry on the business of mechanical, motor, electrical, marine, mining, consulting, and general engineers, &c. The first directors are: J. V. Coonan, 403, Spring Bank West, Hull; W. F. Hall (managing director), Halcyon, Avenue Halcyon, Hessle; H. R. Hall, 4, Alliance Avenue, Hull; D. N. Livingstone, 19, Argyle Street, Anlaby Road, Hull; W. E. Shuttleworth, 216, Victoria Avenue, Hull. Registered office: 195, High Street, Hull.

Steyning Electric Light Co., Ltd. (169,904).—Registered August 26th. Capital, £10,000 in £1 shares. To acquire the business carried on by S. C. D. Oxley at Steyning, as the "Steyning and District Electric Lighting, Heat and Power Supply Co." Minimum cash subscription, £7. The first directors are: W. L. Burt, "Penland," Steyning, Sussex; W. A. Carter, The Gables, Bramber, Sussex; G. A. Flowers, Steyning, Sussex, solicitor; A. Linfield, "Thistledown," Bramber, Sussex; G. S. Mitchell, 31, London Road, Horsham, Sussex; E. Prior (managing director), 30, Church Road, Burgess Hill, Sussex; H. G. Sugden, "Burletts," Bramber, Sussex. Qualification: £200. Secretary: S. C. D. Oxley. Registered office: High Street, Steyning, Sussex.

Institute of Transport (169,896).—Registered August 26th, as a company limited by guarantee, not formed for purpose of profit, the word "limited" being omitted from title by licence of the Board of Trade. The number of members is unlimited, and each member is liable for not more than £1 in the event of winding up. The objects are: To promote and encourage knowledge of traffic science and the art of transport, and the means and appliances connected therewith, to provide facilities for study and the exchange of ideas, to grant certificates, medals, diplomas, and scholarships, to raise the status of those engaged in traffic and transport, to promote exhibitions, to form a library, &c. The income and property of the Institute is to be applied solely towards the promotion of its objects, but payment in good faith of interest, and not more than 5 per cent., on any loans advanced by members, to promote the objects of the Institute. The Institute is to consist of members, associate members, graduates, students, and honorary members. Members and associates only are to be "members" for the purposes of the Companies' Acts. They must have had respectively 10 or 5 years' experience involving official responsibility in dealing with traffic or providing transport or works connected therewith, or fulfil other specified conditions. Members and associates may describe themselves as "M.Inst.T.," and "A.M.Inst.T." The following have consented to become members of the Council, viz.: Sir Eric C. Geddes (Minister of Transport); J. Allen (Oxford Steam Plough Co., Ltd.); Lord Ashfield; J. Bagwell (general manager, G.N.R., Ireland); H. E. Blain; Sir A. A. Booth; Sir J. G. Broadbank (Member, Port of London Authority); Sir A. H. Butterworth (general manager, N.E.R.); H. P. Currie; Sir F. Dent; G. A. Dutfield; Sir J. E. Eaglesome (general manager, Aire & Calder Navigation); Sir S. Fay (general manager, G.C.R.); Sir H. Fitzmaurice; S. E. Garcke (director, British Automobile Traction Co., Ltd.); H. H. Gordon; J. B. Hamilton (commercial manager, City of Leeds Tramways); Sir W. Joynson Hicks, M.P.; R. J. Howley; Sir L. L. Macassey, K.C.; D. A. Matheson (general manager, Caledonian Railway); Sir H. P. Maybury (director-general of Roads); J. C. Mead (Mead, Son & Hussey); J. M. McElroy; Sir P. A. M. Nash (Director-general of Traffic); Sir J. W. Orde (secretary and general manager of R.A.C.); S. Preston (member, Canal Control Committee); Sir W. Raeburn, M.P.; Sir A. Read (managing director, Coast Lines, Ltd.); G. Renwick; Sir A. Stanley (chairman, Tramways and Light Railways Association); E. S. Shrapnell-Smith (Transport Director); F. Tatlow (general manager, M.R.); Sir H. A. Walker (general manager, L. & S.W.R.); J. Willmot, and W. Wolsey (director, Thos. Tilling, Ltd.). Solicitor: R. D. Baxter, 12, Victoria Street, S.W. Registered office: 2-3, The Sanctuary, S.W. 1.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

H. E. Steele, Ltd.—Two mortgages dated August 9th and 17th, 1920, to secure £2,350 and £6,000 respectively, charged on certain land and premises in Westgate and High Street, Cheltenham. Holders: J. P. Winterbotham, Essex Place, Cheltenham, and H. Ripley, J.P., 41, Hans Mansions, S.W.

Slack & Parr, Ltd.—Satisfaction in full on May 18th, 1920, of debentures dated July 31st, 1917, and June 26th, 1919, securing £300 and £1,000 respectively.

J. E. Lester & Folwell, Ltd.—Two mortgages dated August 17th, 1920, to secure £1,500 and £3,500 respectively, charged on 60, London Road, Leicester, and stables, &c., in rear thereof. Holders: Northamptonshire Union Bank, Ltd., and C. Fox, Cropstone, Leicester.

Tok Manufacturing Co., Ltd.—Particulars of £2,000 debentures authorised July 28th, 1920, whole amount issued, charged on the company's undertaking and property, present and future, including uncalled capital.

F. E. Baker, Ltd.—Particulars of £15,000 debentures authorised August 11th, 1920, whole amount issued; charged on the company's undertaking and property, present and future, including uncalled capital.

Precision Engineering Co., Ltd.—Issue on August 12th, 1920, of £500 debentures, part of a series.

CITY NOTES.

The Zurich Bank for Electrical Undertakings.

As a result of the war and the internationality of its transactions, the directors of the Bank fur Elektrische Unter-nehmungen of Zurich have been compelled to bring forward a drastic scheme of reconstruction in order to terminate the present unfavourable situation of the undertaking. The bank was formed many years ago with the co-operation of the German A.E.G. group not only as a holding company, but also as a financing company for electrical undertakings in different countries, particularly German, and its development in the course of years has been regularly recorded in the columns of this journal. The collapse of the currency of Germany and Russia, and the heavy depreciation in those of Italy, France, and Belgium are the primary causes of the present disaster.

The directors of the bank have issued a statement announcing that the accounts for the financial year ended on June 30th, 1920, after the absorption of the whole of the reserve funds, show a loss of 6,666,000 fr., as compared with a deficiency of 4,131,000 fr. in 1918-19. Moreover, there exists what must also be considered as a loss, namely, the "uncovered exchange losses" amounting to 49,344,000 fr., as compared with 18,509,000 fr. in the preceding year. These have hitherto been entered as assets as a result of the order issued by the Federal Council in December, 1919, concerning the consequences of depreciations in the currencies held by companies and co-operative societies. In view of these unfavourable results which are solely due to the depreciation of foreign currencies, particularly the exchange for the German mark, the directors consider that they are no longer authorised to continue the repayment of capital. The holders of the 5 per cent. cash notes and the 4 per cent. bonds maturing on August 31st and October 1st, 1920, have therefore been asked to consent to postponement until the submission of a comprehensive scheme of reorganisation. The scheme will aim at adapting the claims of the various parties interested to the actual conditions now existing, and the capacity of the bank, without causing any displacement of the existing mutual rights of creditors and shareholders.

The following arrangement is proposed for these purposes: (1) The substitution for the bonds, cash notes, and other debts, of preference shares having a cumulative dividend of 6 per cent., and capable of being redeemed by the company at a rate of premium yet to be fixed; (2) the removal of the existing book deficiency by reducing the ordinary share capital to one-fourth of its nominal amount; (3) the replacement of the sum of 750 fr. by which each share is written down by the issue of a profit share of no nominal value, but having a claim on the distribution of profits after the satisfaction of the cumulative dividend of 6 per cent. on the preference shares, as well as a non-cumulative dividend claim of the ordinary shares also of 6 per cent.; and (4) a corresponding rearrangement of the legal conditions in the event of liquidation.

The existing share capital, which is said to be now mainly held in Switzerland, would be reduced under the scheme from 75,000,000 fr. to 18,750,000 fr. The bonds at the end of 1918-19 amounted to 84,340,000 fr., while cash notes for 10,000,000 fr. were in circulation at that time. It is mentioned that full details of the scheme will be given in the company's forthcoming annual report.

Stock Exchange Notices.—Dealings in the following have been specially allowed by the Committee under temporary regulation 4 (3):—

Midland Electric Corporation for Power Distribution.—30,000 ordinary shares of £1 each, fully paid, Nos. 1 to 30,000; and 250,000 new ordinary shares of £1 each, 10s. paid, Nos. 30,001 to 280,000.

Mather & Platt.—210,000 new ordinary shares of £1 each, 5s. paid, Nos. 1,050,001 to 1,260,000.

Clarke, Chapman & Co., Ltd.—Dividend at the rate of 7 per cent. (7s. per share) per annum, less tax, on the 7 per cent. preference shares for the six months ended June 30th, and an interim dividend of 5 per cent. (1s. per share) on the ordinary shares.

Canadian General Electric Co., Ltd.—Dividend of 2 per cent. for the three months to September 30th on the common stock, and 3½ per cent. for the half-year on the preference stock.

Newcastle-upon-Tyne Electric Supply Co.—Interim dividend of 2½ per cent. on the preference and ordinary shares, less tax. First dividend on the new 7 per cent. cumulative preference will be paid September 30th, calculated on the amounts paid up.

City of London Electric Lighting Co.—Interim dividend of 7½ per cent. per annum (9s. per share), less tax, on ordinary shares. Dividend of 6 per cent. on cumulative preference shares.

Kalgoorlie Electric Tramways, Ltd.—The accounts for 1919, after deducting £3,750 for depreciation, show a debit balance of £42,520 to be carried forward.—*Financier.*

Vickers, Ltd.—Interim dividends for the half-year ending June 30th of 2½ per cent., less tax, on the preferred 5 per cent. stock and 5 per cent. preference shares. 2½ per cent., free of tax, up to 6s. in the £, on the cumulative preference shares. The question of interim dividend on the ordinary shares is to be settled when the accounts for the years 1916 to 1919, inclusive, are ready for presentation to the shareholders.

Centrale Pour l'Industrie Electrique.—During last year the Centrale Pour l'Industrie Electrique did business which brought in 1,049,587 fr. net profit, as against 891,009 fr. in the previous 12 months. The dividend was maintained at 25 fr. per share. There was no distribution of dividends in 1917.—*Reuter's Trade Service.*

Stewarts & Lloyds.—Interim dividends at the rate of 6 per cent. per annum on the preference and at the rate of 10 per cent. per annum on the preferred ordinary shares for the June half-year.

STOCKS AND SHARES.

TUESDAY EVENING.

THE shadow imposed upon Stock Exchange markets by the threatened coal strike has already been to some extent relieved by the developments of the past few days. Throughout what some people call the crisis, the House steadily declined to credit the idea of the strike coming to a head, the assumption being that with the public so much opposed to it, and the voting of the men being so considerably in the hands of boys, it is impossible to suppose that there can be any real fear of such a disaster as a strike would involve. Consequently prices have not been flat, although they gave way in certain cases on apprehension of selling. Anyhow, the public sentiment is more cheerful, and Stock Exchange quotations are following this. The firmness of gilt-edged stocks is worthy of notice as exemplifying the steady investment business which continues to flow into Stock Exchange channels in spite of the holiday season and the depressing influences at home and abroad.

The lock-out which is proceeding in various sections of the electrical industry is only part of a policy that is being pursued in other branches of trade. Employers have got to that point at which they decline, in numbers of cases, to accede to any further demands on the part of labour, and, exasperated to the full limit of their patience, they are deciding to close down until a more reasonable frame of mind supervenes amongst their employés. The position is, of course, unpleasant enough for holders in the shares of companies affected by the disturbance, and makes one more reason for dullness in the shares of the electrical manufacturing department. Edison-Swans fell back to 18s. 3d., before they recovered 1s., and Electric Constructions are weak at the former price. Siemens fell to 23s. 6d. India-Rubbers gave way to 25s., Cromptons lost another 1s. at 17s. 6d.

So far as electricity supply shares are concerned, there are not many changes on the week. South Metropolitan preference fell to 17s. ex dividend; Chelseas are better at 2⅞. The rise in the price of coal has come as an unpleasant incident just now, more especially as the miners profess to be working for a substantial reduction in price as one excuse for their threatened strike. It is naturally supposed that earnings of illumination companies will be affected by the rise in coal if this is permanent.

Meanwhile, the City of London Company has declared an interim dividend at the rate of 7½ per cent. per annum, being a rise of 1½ per cent. as compared with that of a year ago. This is a distinctly cheering performance, and has made the price of the shares a little firmer at 23s. 6d. Moreover, it encourages the hope that, after all, electric lighting companies may be able to maintain their distributions of last year provided the coal outlook clears up before the final accounts are adjusted, for which, of course, there is plenty of time. The yield on the leading shares is exceedingly good, and when 10 per cent. or thereabouts can be obtained from investment in Westminsters, as well as other first-class shares in the list, it is not likely that proprietors are going to part with their holdings at such levels as rule to-day.

The market in cable shares is better, Eastern Extensions hardening to 14¼ and Globes to 15, although these improvements merely replace falls which occurred last week. Anglo-American preferred is a point up at 80½. Marconis have kept steadily around 2 13-16. Marconi Marines, after touching 1⅛, went back to 31s. 3d. The American Telephone and Telegraph Company is joining forces with the General Electric Company of New York, and associated with these is the Radio Corporation, more familiar on this side as the American Marconi Company, dealings in the shares of which are not yet permitted in the Stock Exchange.

Home Railway stocks are inclined to recover after passing through a period of weakness on account of the coal outlook. Underground incomes at 55½ are 2 points lower, and the £10 shares at 32s. 6d. have fallen 2s. 6d. Central London ordinary and Metropolitans are both down. Nor is the foreign list in much better case. Mexicans are heavy, and British Columbia Electric preference at 52½ are 2 down. Iron, steel, and kindred shares are better. There was a sharp fall in Vickers to 21s. 3d., on the passing of the interim dividend, but a recovery to 24s. 6d. occurred early this week, and was accompanied by substantial improvement in various other armament, engineering and coal issues. The rubber market is very quiet, with the price of the raw produce about 1s. 9½d. per lb., and no business worth mentioning in any of the various sections devoted to rubber shares.

From the spectacular point of view, the principal feature of the last few days has been the rise in dollar securities. Owing to the drop in the value of the £ in terms of the dollar, Montreal Light & Power Common shares have risen 20 points to 290. Improvements of 3 to 5 dollars have made Canadian General Electrics 123, New York Telephone 4½ per cent. bonds 101, Kaministiquia capital shares 110½, Electric Development of Ontario fives 111½, Bell Telephone of Canada fives 110½, Shawinigan 134, and so on. There are probably a good many bonds of this class still held over here, and, although the New York exchange may move further against this country, it must be acknowledged that the current quotations are distinctly tempting from the point of view of those who take the longer outlook and who foresee the time when, with a less abnormal rate of exchange, such prices as those just quoted will certainly not obtain. The securities are mostly out-of-the-way stocks, and the changes may not be noticed by holders unless brought to their attention in this manner. Against these sharp advances, the only fall to be chronicled is in Calgary Power shares, which have dropped to 12½, a loss of 5 points this week.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Aug. 31, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	6½xd	—	£3 12 0
Charing Cross Ordinary	4	7	9½	—	10 15 6
do. do. do 4½ Pref.	4½	4½	92	—	8 3 8
Chelsea	3	4	32	+ ½	7 5 6
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	7½	— ½	10 9 10
do do. 6 per cent. Pref.	6	6	8	—	7 3 0
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	1½	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8xd	+ ½	10 0 0
Metropolitan	5	6	32	—	10 18 0
do. 4½ per cent. Pref.	4½	4½	31½	—	8 0 0
St. James' and Pall Mall	10	12	6½	—	9 1 2
South London	5	6	24	—	9 12 0
South Metropolitan Pref.	7	7	17/-xd	- 1/-	8 4 8
Westminster Ordinary	8	10	5	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	85½	+1	7 9 0
do. Def.	22/6	1½	17½	—	8 11 6
Chile Telephone	8	6	6	—	*5 0 0
Cuba Sub. Ord.	7	7	7½	— ½	*9 6 8
Eastern Extension	8	10	14½	+ ½	*6 14 5
Eastern Tel. Ord.	8	10	14½	—	*6 14 4
Globe Tel. and T. Ord.	8	10	15	+ ½	*6 13 4
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	22	21	—	10 4 8
Indo-European	13	16	80	—	8 6 8
Marconi	25	25	2½	—	8 8 0
Oriental Telephone Ord.	10	12	2½	—	*4 16 0
United R. Plate Tel.	8	8	6½	—	*6 1 0
West India and Panama	1/8	Nil	⅛	—	Nil
Western Telegraph	8	10	15	—	*6 13 4
HOME RAILS.					
Central London Ord. Assented	4	4	41½xd	- 1	9 12 10
Metropolitan	1	1½	19½	- ½	6 8 2
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1½	- ½	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	5	4	55½	- 2	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	8½	—	8 9 2
do. do. 2nd Pref.	Nil	Nil	8½	—	Nil
do. do. 5 Deb.	5	5	57½	—	8 12 6
Brazil Tractions	Nil	Nil	47	—	Nil
Bombay Electric Pref.	6	6	132	—	4 10 0
British Columbia Elec. Rly. Pfce.	5	5	52½	- 2	9 10 6
do. do. Preferrred	2½	5	48½	—	*7 2 6
do. do. Deferred	Nil	3	50½	—	*6 19 0
do. do. Deb.	4½	4½	65	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	39	—	Nil
do. 6 per cent. Bonds	Nil	Nil	28	—	Nil
Mexican Light Common	Nil	Nil	18	—	Nil
do. Pref.	Nil	Nil	23½	- 2	Nil
do. 1st Bonds	Nil	Nil	61	+1	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3½	—	*6 0 0
British Aluminium Ord.	10	10	1	—	10 0 0
British Insulated Ord.	12½	15	11½	—	8 5 6
Callenders	25	15	1½	—	11 8 6
6½ Pref.	6½	6½	18/-	—	7 4 5
Castner-Kellner	20	17	3	—	5 13
Crompton Ord.	10	10	17/6	- 1/-	11 8
Edison-Swan, "A"	10	10	19/3	- 2/-	10 7
do. do. 5 per cent. Deb.	5	5	79½	—	6 5
Electric Construction	10	10	18/3	—	10 19
Gen. Elec. Pref.	6½	6½	18/6	—	7 0
do. Ord.	10	10	13	—	*7 5
Henley	25	15	1½xd	+1/-	9 11 5
do. 4½ Pref.	4½	4½	3½xd	—	6 18 6
India-Rubber	10	10	1½	- 9d.	*8 0 0
Met.-Vickers Pref.	—	8	2½	—	7 5 2
Siemens Ord.	10	10	23/6	- 1/-	*8 10 2
Telegraph Con.	20	20	20	—	*6 0 0

* Dividends paid free of Income Tax.

NOTES ON THE TEMPERATURE COMPENSATION OF MOVING-COIL AMMETERS.

By F. T. CHAPMAN, D.Sc. and A. T. MORRIS, B.Sc.

Continuous currents of any magnitude can be measured by means of a moving-coil instrument in conjunction with shunts of suitable resistances. The moving coil is usually wound with fine insulated copper wire, and the control springs, which also serve to carry the current into and out of the moving coil, are made of some alloy, such as phosphor-bronze. A modern shunt is constructed of strips of some material which has a very low resistance-temperature coefficient, such as manganin or eureka. These strips are soldered into large copper terminal blocks, to which the cables carrying the current are bolted. Two small terminals on the copper blocks serve to connect flexible leads to the instrument circuit. Since the shunts are of practically constant resistance, a given current will apply a definite potential difference to the moving coil, and will therefore produce a given deflection on the instrument scale. If now the temperature of the moving coil varies by reason of changes in the air temperature and of the heat generated in it, its resistance will also vary to the extent of about 0·4 per cent. per degree Centigrade. This will cause the current and deflection to vary, also to the same extent. It has been suggested that if the shunts were all made of copper, this would automatically compensate for any temperature changes, and if the temperatures of the moving coil and shunt remained the same, this would be the case. However, the shunts would have to be rather bulky to obtain the necessary resistance, and in practice the cooling facilities of the shunt and coil differ greatly, so that temperature differences would be inevitable. In order to get adequate compensation for these temperature changes several methods may be adopted.

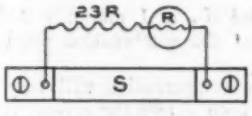


Fig. 1.

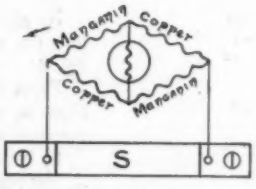


Fig. 2.

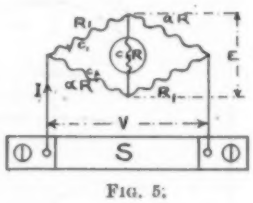


Fig. 5.

Method I.—The first method is to insert an extra resistance made of manganin or eureka in series with the moving-coil circuit, and thus reduce the temperature coefficient of the whole system. If R is the resistance of the moving coil and control springs at 60° F., and if we put about 23 times this resistance of manganin in series, the temperature coefficient of the whole circuit will be reduced from 0·238 per cent. per degree F., to about 0·01 per cent. per degree F. A change of temperature of 20° F. would then produce an error of only 0·2 per cent., which would be within the range of sub-standard accuracy. However, putting such a large resistance in series with the moving coil necessitates a much higher voltage across the shunt in order to produce the normal working current in the moving coil. This voltage might be as high as one volt, and the shunt becomes unduly large, and a lot of power is also wasted. This method then is best applicable to cases where such a high standard of accuracy is not necessary, and then the series resistance need not be more than, say, eight to ten times the moving-coil resistance. The diagram of connections employed in this method is shown in fig. 1.

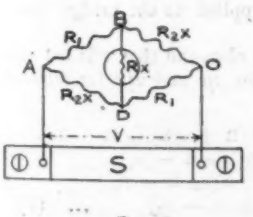


Fig. 3.

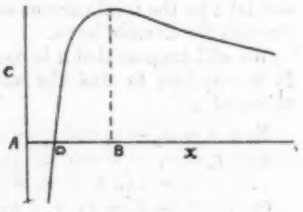


Fig. 4.

Changes in temperature also affect the instrument in other ways than by changing the resistance of the moving coil, such as changing the strength of the control springs, and affecting the strength of the magnetic field produced by the permanent magnet. The errors thus produced will depend on the material of which the springs are made, and on the quality of the magnet steel, but the following are average values of the errors involved. Control springs decrease in stiffness about 0·02 per cent. per degree F. rise in temperature, and the permeability of the steel magnet decreases about 0·01 per cent. per degree F. rise. It will be observed that these errors tend to cancel out, and in many cases very nearly do so.

Method II.—The second method consists of using a four-armed bridge circuit made up of copper and manganin or eureka resistances. Opposite arms of the bridge are made of similar material, the moving coil being connected between two of the opposite junctions and the potential leads to the other opposite pair, as in fig. 2.

It is found that if the resistance of each copper arm is about equal to the moving-coil resistance, and if each manganin arm is about one-third of the resistance of the copper arm, very good compensation is obtained. This compensation is, however, only between certain temperature limits, and there are many other combinations which will also give the required compensation. It is proposed to show in this article how the compensation is obtained, and also to show graphically how the compensation varies with different combinations of resistances in the bridge arms.

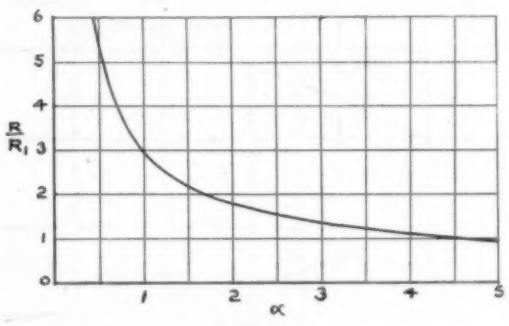


Fig. 6.

Let R ohms be the resistance of the moving coil at 60° F., and let Rx be its value for a temperature T° F., so that x will be equal to $1 + (T - 60)\,0{\cdot}00238$.

In fig. 3 let A B, D O represent the arms of manganin wire, each of resistance R_1 ohms, and let A D, B O represent arms of copper wire, whose resistance will be $R_2 x$ ohms each. A constant current flowing in the shunt S will produce a constant potential difference between A and O, and we will call this V volts.

Let c, c_1, c_2 be the currents respectively flowing in the arms Rx, R_1, $R_2 x$.

Then we have $v = c_1 R_1 + c_2 R_2 x$, ... (1)
and also $v = 2 c_1 R_1 + c R x$, ... (2)
and $c_2 = c_1 - c$.

Therefore $2 c_1 R_1 + c R x = c_1 R_1 + (c_1 - c) R_2 x$,
whence $c_1 = c (R x + R_2 x)/(R_2 x - R_1)$.

Substituting this value of c_1 in equation (2), we get—

$$v = 2 c R_1 (R x + R_2)/(R_2 x - R_1) + c R x$$
$$= c x [2 R_1 R_2 + R (R_1 + R_2 x)]/(R_2 x - R_1)$$
$$\therefore c = v (R_2 x - R_1)/x [R (R_1 + R_2 x) + 2 R_1 R_2]$$
$$= v \left(R_2 - \frac{R_1}{x} \right) /[R (R_1 + R_2 x) + 2 R_1 R_2] \quad (3)$$

This expression represents the current in the moving coil, and by substituting various values of x in it, we can see how c will vary with x.

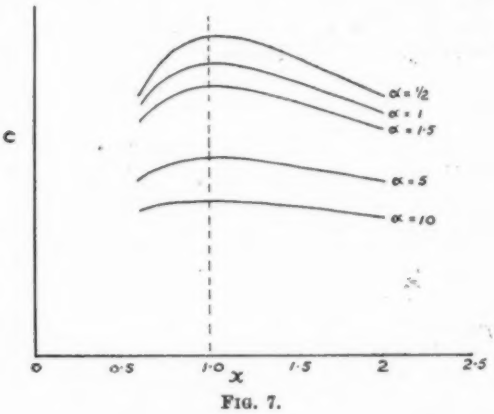


Fig. 7.

Let x be infinite, then c approaches zero. If x equals R_1/R_2, c is nothing, and if x is nothing, c has a value of minus infinity. By putting in other values of x, and giving R, R_1, R_2 definite values, we find the general shape of the curve for c is that given in fig. 4.

When $x = R_1/R_2$, represented by A D, c is zero, and for some value of A B greater than R_1/R_2, the curve reaches a maximum. On either side of this value A B, the current c

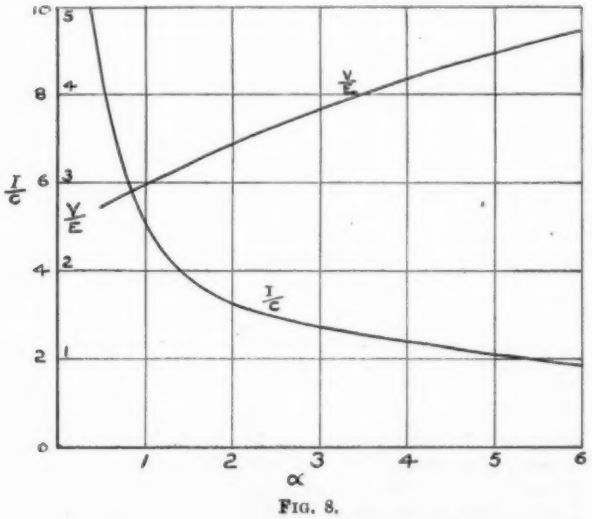


Fig. 8.

is approximately constant for a small variation of A B, and it is this part of the curve which is used to obtain the necessary compensation. The value of x at A B may be considered as unity, and the limits of x for temperature changes of, say, 20° F. would then be $1 \pm 20 \times \cdot00238$, *i.e.*, between 1·0476 and 0·9524. We have seen that x must be greater than R_1/R_2, and hence R_2 will be greater than R_1. In general, the resistance R of the moving coil will be known, and it remains to find what values of R_1 and R_2 will give us maximum values of c. The copper arm will now be considered as some multiple of R, and will be taken as equal to $a R$ where a is a variable.

Fig. 5 shows the new arrangement of resistances. Let R be known, and let the copper arms have each a resistance of $a R$ ohms where a is a variable quantity, and let R_1 be the resistance of the manganin arms, as before. Since we are now only considering changes in $a R$ at a given temperature for which x equals unity, we can omit it from our expressions.

Substituting $a R$ for R_2 in (3), we get—

$$c = v (a R - R_1)/R (R_1 + a R + 2 R_1 a) \quad ... \quad (4)$$

Now v is constant and R is known, so that we can find how R_1 will vary with a.

Differentiate equation (4) with respect to R;
then $dc/dr = [(a R^2 + 2 R_1 R a + R R_1) a - (a R - R_1)(2 a R + 2 R_1 a + R_1)] \div R^2 (R_1 + 2 a R_1 + a R)^2$.

Equating this to zero we get—

$$a^2 R^2 - 2 a R R_1 - 2 a R_1^2 - R_1^2 = 0 \quad ... \quad (5)$$

whence $R/R_1 = (1 \pm \sqrt{2 + 2 a})/a$ ... (6)

By giving a different values we obtain a curve showing how the ratio R/R_1 varies with a, and this curve is given in fig. 6.

From this curve we see that if a is 1 and R is 3 ohms, then R_1 is 1 ohm, which was the combination previously mentioned.

In order to show how the compensation will vary with a, curves of current have been drawn for several values, and these are given in fig. 7. From them it will be seen that as a increases, the curves get flatter near the maximum point, and hence the current will be more constant over a given range of temperature variation.

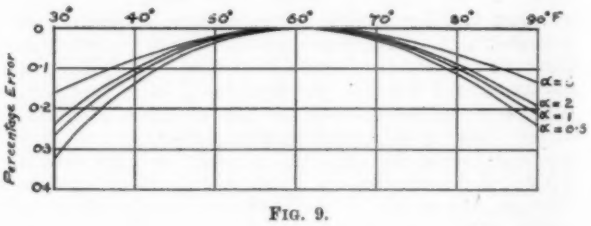


Fig. 9.

It should also be observed, however, that the current c and the sensitiveness of the combination decrease as a increases, and we must therefore consider the effect that varying a has on the ratio between c and the total bridge current $(c_1 + c_2)$, and of the voltage across the moving coil to v, the shunt voltage.

In fig. 5 let E be the voltage across R, the moving coil, and let I be the total current supplied to the bridge circuit through the flexible leads.

We will suppose that R is one ohm and that v is 0·1 volt. It is required to find the ratios I/c and v/E for different values of a.

Now $I = c_1 + c_2$ and $c_1 = c (R + a R)/(a R - R_1)$,
also $c_2 = c_1 - c = c (R + R_1)/(a R - R_1)$,
$\therefore c_1 + c_2 = c (a R + R_1 + 2 R)/(a R - R_1)$,
or $I/c = (a R + R_1 + 2 R)/(a R - R_1)$ ... (7)

From this equation the ratio I/c may be plotted for various values of a, and the curve is shown in fig. 8.

With regard to the ratio v/E, from equation (4), we have

$$c = v (a R - R_1)/R (R_1 + a R + 2 R_1 a)$$

and $E = c R$,

$$\therefore v/E = (R_1 + a R + 2 R_1 a)/(a R - R_1) \quad ... \quad (8)$$

This curve is also shown in fig. 8 for different values of a, and it will be noticed that as a increases the ratio I/c decreases, but the ratio v/E increases. For efficient working I/c should be kept low, that is, a should have a high value, but at the same time v/E should be kept low, or a should have a low value. It will, therefore, be seen that a compromise must be made, and probably a will have some value between 1 and 2. Using the same figures as in fig. 8, values of current have been calculated for two or three values of a over a given range of temperature, and the curves

in fig. 9 show the percentage error at various temperatures. From these it will be observed that very good compensation may be obtained without sacrificing too much sensitiveness.

Method III.—In the third method, a manganin, or Eureka, resistance R_1 is placed in series with the moving coil R x, and a second copper resistance R_2 x is placed in parallel with R x and R_1. A third manganin resistance R_3 is put in series with both of these, as shown in fig. 10, which also shows the connections to the shunt S.

The value of c, the current in the moving coil, is given by the equation—

$$c = V R_2 x/(R R_2 x^2 + R_1 R_2 x + R_2 R_3 x + R_3 R x + R_3 R_1),$$

and the curve of current for different values of x is somewhat similar to that in the second method, compensation

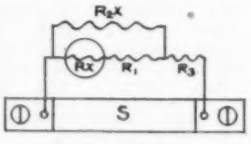


Fig. 10.

being obtained in the same way. The chief disadvantage of this method is the rather higher voltage required across the shunt.

In conclusion, we would point out that the effect of the leads between the instrument and its shunt has not been included. Unless the resistance of these is kept low in comparison with that of the instrument, it will affect the compensation adversely. It is, however, comparatively simple to have leads of quite low resistance. There is one other assumption to which attention should be drawn—viz., that the temperature of the copper bridge arms is the same as that of the moving coil. However, since all of them are heated by the currents they carry, the rise in temperature above that of the rest of the instrument, due to this cause, would be approximately the same for them all.

LINE SHAFTING, COUPLINGS, AND JOURNAL SEATS.

By J. T. TOWLSON.

The subject of the present article is "Line-shafting, couplings, and journal seats," and consideration will be given to these, with the view of enlightenment as regards the comparative utility of the orthodox and the new, with special reference to their adaptability, or otherwise, to inexpensive erecting, and also (which is of equal importance) dismantling.

Take, for example, a line of light shafting, say, 1 in. in diameter, having various muff-couplings, keyed, or keyed and screwed, to their respective ends.

The bearings for such a size of shaft would hardly be halved bearings, but would be solid. So, to erect such a shaft it would be necessary to thread each length of shaft through one or more bearings and couple up as one goes along, with keys and screws or keys alone. We need not be told how such a line of shafting generally runs, and we can visualise many running "out of true" and wobbling about in such a way as to be a painful sight to a mechanic.

And again, when for one reason or other, it is required to dismantle the shaft, *i.e.*, to take it down out of its bearings and uncouple—that, indeed, is a bigger and a more tortuous job than its erection. The keyed couplings have to be taken off, and often the hangers have to be taken down, so as to get room for the shafts to be drawn out of their solid bearings.

Now, my ideal of a line shaft and its appurtenances is this:—I must have a coupling, good and inexpensive, which can be fixed to the shaft in a few minutes, and taken off quite as quickly; no matter how many times it is applied or taken off, no damage accrues, and it trues the shaft at the joint every time it is put on. It must have no keys, it must have no screws, and yet be just as firmly joined in respect of the various lengths in the line as if it possessed both keys and screws.

It must also have journal seats, equal to, and even better than, the usual solid bearings, but provision must be made for the whole of the line, or (when uncoupled) a part of the line, to be easily lifted out of its journals, and where no end motion is required, as in the orthodox bearings.

How nearly the author's design satisfies the ideal may be judged from the following sketches and description.

Fig. 1 shows A and B, the two ends of shafts joined together by the halved coupling C, and meeting at the non-square faces D. The two halves of the split coupling are held together by nuts, as shown, and, further, more intensely gripped to the shaft by means of the 30° seats, on which the tapers of the nuts bear when pulled tightly up. The usual provision is made to allow of this by clearing the thread away a little on its entering side.

The shafts have recesses 1 in. wide and $\frac{3}{8}$ in. diameter, into which corresponding parts of the halved coupling fall. Now, it will be readily perceived that the provision of these shouldered recesses jointly with the non-square ends of the shafts, effectively locks both shafts together and compels them to run as one shaft. It is, as reasonably claimed, an automatic lock—firm, rigid, durable and always true—and may be applied or taken off in a few minutes. That is the coupling.

Figs. 2 and 3 show the bearing:—A is the usual hanger, B is a bush. The bush is solid, and when the bushes are drawn along the shaft, out of the way of each bracket, the shaft may be dropped into the brackets by way of the gap C, and the bushes pushed endwise into position and held by the screw D. To dismantle the shaft, slip the bush endwise, clear of the bracket, and lift the shaft out bodily. It is the opinion of the writer that such details as these

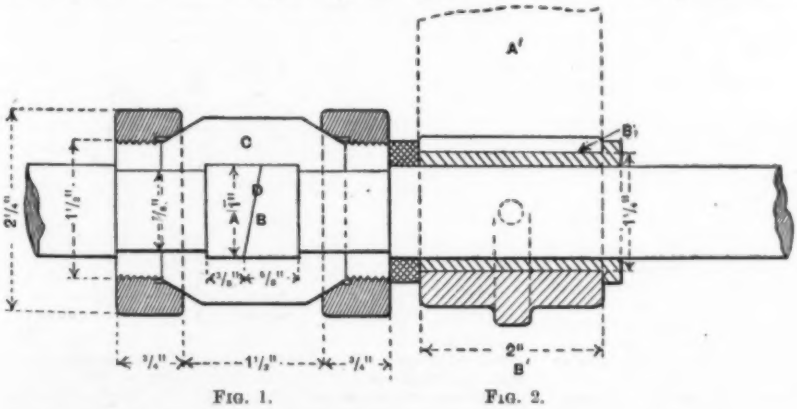


Fig. 1. Fig. 2.

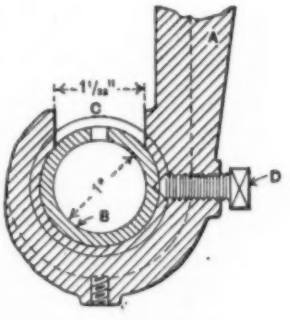


Fig. 3.

improvements comprehend may be called a system, and that manufacturers would do well to adopt it. Placed in good hands, each coupling should cost but a few coppers, and the bearings would be equally inexpensive to produce.

The line shafting of such small dimensions as 1-in. dia., usually seen in factories and driven by electric motors, would be vastly improved both in appearance and in running costs by a wise application of the system set forth above.

EXTRA LONG-DISTANCE TRANSMISSION OF ELECTRICAL ENERGY.

Principles and Applications of the Quarter-Wave and Half-Wave Systems.

(*Concluded from page* 283.)

Artificial Half-Wave Lines.—Comparison between Tables V and VI shows that half-wave transmission makes possible transmission over a distance of 1,500 miles, or so, with better voltage regulation than is possible in ordinary transmission over one-fifth of this distance. Also, the power factor of the load has no considerable effect on the regulation of such a system. The question arises whether half-wave characteristics cannot be imparted artificially to a shorter line. By modifying the inductance and capacity, can we not combine the high efficiency of a line, say, 300 miles long (Table VI) with the excellent voltage regulation of a half-wave system (Table V)? If we can do this for a 300-mile line, it will be easier to do it for a longer line, whilst for shorter distances ordinary transmission is sufficient. Let us begin by considering the case of an underground cable.

Half-Wave Transmission for 315 miles (500 km.) by Underground Cable.—We may as well consider at once an extreme case, viz., a phase pressure of 100,000 volts (173,000 volts between lines), and a conductor section of 5 sq. cm. in aluminium, or the equivalent in copper. In the absence of actual data concerning the characteristics of such a cable, we may take $r_1 = 0.07$ ohms per km.; $L_1 = 0.0003$ henry per km.; and $C_1 = 0.1$ mfd. per km. Leaving out of consideration for the present an increase in capacity, we must increase L_1 to $L_1' = 0.004$ henry per km. in order to secure half-wave characteristics for a distance of 500 km. at 50 cycles per second. This necessitates the connection of inductance coils at intervals in the line to increase the inductance by $0.004 - 0.0003 = 0.0037$ henry per km.

Assuming the use of one reactance coil per km., this might be built to the following specification:—Iron section, 420 sq. cm.; length of iron, 30 cm.; number of turns, 42. Magnetic circuit open at the ends, and even including some small gaps in its length so that there may be added to the ampere-turns required by the iron those required by 2·5 cm. of air at equal induction. The weight of iron in such a coil would be 260 kg. When transmitting a maximum power of 100,000 KW at a minimum power factor of 0·7, the current per phase = 333 amperes and the total effective current = 476 amperes, corresponding to an induction of 10,000 gauss. The loss in the plates is then about 800 watts, or, say, 1,200 KW. for all the reactances in a 500-km. line, *i.e.*, about 1.2 per cent. of the delivered power. The length of the windings is about 45 m. per coil, representing an addition of 4·5 per cent. to the resistance of the line. These losses might be reduced by adopting a more expensive construction for the reactances. By mounting the whole reactance on suitable insulators, it would be unnecessary to insulate the core from the windings for 100,000 volts.

It is unnecessary to calculate the station pressure, current, and power factor as a function of the delivered load, because the results would be exactly analogous to those given later for overhead lines. Two points, must, however, be verified:—(1) The practically constant current at the centre of the line must be acceptable in value. Actually it is about 500 amperes, *i.e.*, practically equal to the full-load current at the two ends of the line. (2) The voltages at the mid and quarter-points of the line (which are the danger points) must be acceptable, with maximum current and lowest power factor. At $\cos\phi = 0.7$, with 333 amperes in phase and 339 amperes in quadrature, the voltage at the centre is 95,200 volts, and at the quarter-point 126,000 volts. The maximum over-voltage is thus about 26 per cent., and, to reduce it, we may either:—(*a*) reduce the maximum current, *i.e.*, the power transmitted, or (*b*) obtain half-wave characteristics in the line by increasing the capacity of the system and using smaller reactances. This method is considered more fully in connection with overhead lines.

Half-Wave Transmission for 315 miles (500 km.) by Overhead Conductors.—The difficulties being greater, we may here consider two extreme cases, viz.—(1) Three 50 sq. mm. aluminium lines transmitting a maximum of 12,000 KW. at 173,000 volts between lines. (2) Three aluminium conductors of 400 to 500 sq. mm., transmitting up to 100,000, or even 150,000 KW. The working frequency is taken to be 50 cycles per second in both cases.

Case I.—The 50 sq. mm. line consists of three aluminium cables, 0·9 cm. overall diameter, 450 cm. apart, and 12 m. (average) above ground. Then $r = 0.65$ ohm per km.; $L_1 = 14.3 \times 10^{-4}$ henry per km.; C_a (between lines) = 0·008 mfd. per km. Adding an earth wire at the same mean distance, we have a supplementary capacity $C_b = 0.008$ mfd. per km. The capacity with regard to earth is $C_e = 0.0064$ mfd. per km. It is not necessary to add these component capacities, owing partly to the poor conductivity of the soil and chiefly to the fact that each component is modified by the presence of the others. The value taken for C_1 is, therefore, 0·0111 mfd. per km.

In order to obtain half-wave characteristics in the line by increasing the inductance alone, it is necessary to add about 0·0345 henry per km. The transmission characteristics of the line may then be tabulated as in Table VII, from which it will be seen that:—(1) The light-load current is small and the power factor nearly unity. (2) The station voltage is practically independent of the power-factor of the load, and the slight variation in this voltage with load can be provided easily by automatic regulators. (3) The efficiency is rather low, but could be increased by adding to the weight of conductors, which is at present about 17·5 kg. per KW. delivered.

The current at the mid-point is 55·5 amperes, *i.e.*, less than at the ends of the line. The pressure at the mid-point for 12,000 KW. and $\cos\phi = 0.7$ is 10,300 volts; and at the quarter point is 133,000 volts. This is an over-voltage of 33 per cent., which increases on overload unless the power factor be high. With a load of 18,000 KW. at about unity power factor, the voltage is 108,000 volts at the centre, and 105,000 volts at the quarter-point.

TABLE VII.—Half-Wave Transmission for 315 miles (500 km.) by three 50 sq. mm. Overhead Aluminium Lines.

Delivered at 100,000 volts.			Input.				Efficiency. %
Power, KW.	Power factor.	Current, amps.	Pressure, volts.	Current, amps.	Power factor.	Power, KW.	
12,000	1·0	40·0	106,900	45·2	1·000	14,500	81·7
	0·9	44·5	106,800	49·1	0·932	14,650	81·8
	0·8	50·0	106,800	54·1	0·860	14,900	80·5
	0·7	57·1	106,900	60·8	0·784	15 250	78·7
6,000	1·0	20·0	103,700	25·2	1·000	7,850	76·5
	0·9	22·2	103,600	26·9	0·940	7,850	76·5
	0·8	25·0	103,600	29·2	0·876	7,950	75·5
	0·7	28·6	103.600	32·3	0·799	8,000	75·0
Open circuit	—	—	100,400	5·1	0·9994	1,530	—

Automatic circuit breakers might be installed to interrupt overloads at low power factor, and the points on the line which would be exposed to serious over-voltage in event of slow operation of the circuit breakers might be protected specially, or provided with reinforced insulation. Within certain limits, the voltage distribution along the line may be changed by not distributing the additional inductance uniformly. Also, the over-voltage on overload might be reduced by increasing the saturation in the reactances so as to reduce the inductance to heavy currents, but this expedient is not free from objections.

M. Bunet shows that the requisite additional inductance (0·0345 henry per km.) could be provided by connecting at intervals of 10 km. in the line, reactance coils of 0·345 henry having an iron section of 720 sq. cm., length of iron 80 cm., and a number of turns 240. The weight of iron in such a reactance would be 450 kg.; the total iron loss would be less than 2 per cent. of the delivered power; and the reactance windings would add about 3·5 per cent. to the line resistance.

Case II.—The characteristics of the line with three 400 sq. mm. aluminium conductors would be:—$r_1 = 0.085$ ohms per km.; $L_1 = 0.0012$ henry per km.; $C_1 = 0.0143$ mfd. per km.; L_1' (for half-wave characteristics) = 0·028 henry per km. Table VIII shows the transmission characteristics obtained, and comparing this table with Table VI (relating to ordinary transmission of similar power by three 500 sq. mm. cables), it will be seen that the voltage regulation is incomparably better in the half-wave system, and that the station voltage can be regulated much more easily to maintain constant delivered voltage. A section of 400 sq. mm. is assumed above, but in order to allow for the losses in the reactance coils, the line section may be increased to 500 sq. mm., whilst retaining $r = 0.085$ ohm per km. The two lines are then strictly comparable.

TABLE VIII.—Half-Wave Transmission for 315 Miles (500 K M.) by three 400-sq. mm. Overhead Aluminium Lines.

Delivered at 100,000 volts.			Input.				Efficiency, %
Power, KW.	Power factor.	Current, amps.	Pressure, volts.	Current, amps.	Power factor.	Power, KW.	
150,000	1·0	500	110,600	501·1	1·000	166,200	90·2
	0·9	556	110,700	556·5	0·923	170 200	88·2
	0·8	624	110,900	624·1	0·845	175,100	85·5
	0·7	714	111,100	718·0	0 768	182,200	82·3
75,000	1·0	250	105,300	251·1	1·000	79,500	94·3
	0·9	278	105,300	279 0	0·911	80,400	93·3
	0 8	312	105,400	312·5	0·829	81,900	91·6
	0·7	357	105,400	357·2	0 738	83,400	90·0
37,500	1·0	125	102,600	126·1	1·000	38,900	96·4
	0 9	139	102,600	139·8	0·906	39,000	96·1
	0 8	156	102,600	156·7	0 816	39,400	95·3
	0 7	178	102,600	179·0	0·719	39,600	94·8
Open circuit	—	—	100,000	1·1	1·000	330	—

The ratio between the station voltage when delivering 75,000 KW. at 0·7 power factor, and that on open circuit is 1·95 in the case of the ordinary transmission system (Table VI), and only 1·05 in the half-wave line (Table VIII). Transmission of 150,000 KW. would be practically impossible in the "ordinary" case considered, but would require only about 10 per cent. increase on the open circuit voltage in the case of the half-wave system. Finally, the light-load current is 163 amperes at $\cos\phi = 0.045$, *i.e.*, 49,000 K.V.A., in the ordinary transmission, compared with 1·1 ampere at $\cos\phi = 1$ *i.e.* 330 K.V.A. in the half-wave system.

Unfortunately, the over-voltages *en route* make impracticable the actual half-wave system considered, but if the half-wave characteristics were obtained by increasing the capacity (and not merely the self-induction), Table VIII would represent a practicable case.

The current at the centre of the half-wave line would be about 71 amperes at all loads (including light load), that is, only one-tenth of the maximum current at the end of the line. The phase-voltage at the centre of the line when delivering 150,000 KW. at 0·7 power factor is about 1,000,000 volts, *i.e.*, 1,730,000 volts between lines. At the quarter-point the phase voltage is 760,000 volts, or 1,300,000 volts between lines. Whatever may be the progress of the future, it is evident that these pressures are far above the practicable limit. The maximum power which could be transmitted for 315 miles (500 km.) by a half-wave line operating at 100,000 volts phase pressure is about 12,000 KW., but this limit could be raised considerably—possibly to 50,000 KW.—by increasing the capacity.

Combined Overhead and Underground Transmission by Half-Wave System.—A half-wave, 50-cycle line 500 km. long must be such that the product of self-inductance per km. L_1 and capacity per km. C_1' is about 4×10^{-10}. On the other hand, the over-voltage is determined by $\sqrt{(L_1'/C_1')}$, and may be halved by doubling the capacity and halving the inductance, the half-wave characteristic of the line being unaffected by this readjustment of constants.

If, for example, three-fourths of the transmission were by overhead line and one-fourth by underground cable, the two being regularly interspersed in short sections, we should have :—

	Overhead.	Underground.	Resultant.
Self-inductance, henry per km.	0·0012	0·0003	0·000975
Capacity, mfd. per km. ...	0·0143	0.1	0·0357

Then, if reactance coils were added to bring the inductance up to 0·0112 henry per km., the phase voltage would be 96,000 volts at the centre and 128,000 volts at the quarter-point when transmitting 120 amperes per phase, *i.e.*, 36,000 KW. If the proportion of underground cable were increased to half, 50,000 KW. could be transmitted under the same conditions.

Split-Conductor Lines for Increased Capacity.—If, instead of using a single conductor for each phase, we were to use two conductors for each phase, these being, say, 50 or 100 ft. or more apart, the capacity current would be doubled, but for a given current in each line the inductance drop would be the same, *i.e.*, it would be divided by 2 if referred to the total current. In other words, whilst retaining purely overhead transmission, we should have a circuit of doubled capacity and halved inductance.

Instead of two lines per phase, we might use 10 or more ; thus instead of transmitting 150,000 KW. by a single line (Table VIII), we might use 10 lines, each with conductors of 50 sq. mm. Apart from practical problems, this offers a means of effecting all transmission on the half-wave system.

It would not be convenient as a rule to have such a multitude of lines. A compromise might be effected by reducing the spacing of the lines to, say, 20 cm. Instead of towers, portal-frame supports might be used with three cross members, on which would be slung the conductors of the three phases. Between supports the parallelled conductors would be tied together to equalise sag and prevent twisting. Above (and below also if desired) there would be a layer of earthed conductors, and the three series of line conductors would be transposed at intervals to equalise the characteristics of each phase.

The inductance of such a split-conductor line would be much lower than that of a single wire, but the capacity would be increased in the same proportion, the product of inductance and capacity remaining constant.

Suppose that instead of a single cable of 500 sq. mm. section, we use 20 cables each of 25 sq. mm. slung in the same horizontal plane 20 cm. apart, each of them with a central steel wire and six aluminium strands. Then the total capacity, between line wires, between the latter and earth wires, and between line conductors and earth, will be about 0·03 mfd. per km., compared with 0·00773 mfd. per km. for a single 500 sq. mm. cable relative to another at 450 cm. To give the line half-wave characteristics, reactance coils would have to be added, bringing the inductance up to 0·008 henry per km. Then for 50,000 KW. at 0·7 power factor the delivered current = 238 ampere per phase ; the current at the centre of the line would be 250 ampere at 95,200 volts per phase, and the pressure at the quarter-point would be 128,000 volts per phase. Thus four times greater power could be transmitted by the split-conductor system than by the single-conductor system.

It should be noted that all the above examples relate to a transmission distance of 315 miles (500 km.). If the distance be increased to 440 miles (700 km.), the problem is greatly simplified, because the distance being increased by the factor 1·4 the product $L_1' C_1'$ is divided by $(1{\cdot}4)^2$, *i.e.*, practically halved. Halving the inductance, whilst keeping the capacity constant, we have $\sqrt{(L_1'/C_1')}$ divided by 1·4 and the over-voltage therefore reduced in the same ratio. As a result, we could transmit 17,000 KW. by the single-conductor system, and 70,000 KW. by the split-conductor system.

The Condenser Problem.—The general solution of the problem is clearly dependent upon the realisation of high-power condensers, suitable for industrial service. Returning to the half-wave transmission for 315 miles, using three 400 or 500 sq. mm. cables (Table VIII), which was satisfactory except as regards over-voltages :—The factor $\sqrt{(L_1'/C_1')}$ was 1,400 under the conditions previously assumed. If we reduce this factor to 120 by increasing the capacity and reducing the inductance, we find that (for 150,000 KW. at $\cos\phi = 0{\cdot}7$) the current at the centre is 833 amperes at 86,000 volts, and the pressure at the quarter-point is 123,000 volts. These are acceptable values, and to obtain them we must make $L_1' = 0{\cdot}0024$ henry per km. (*i.e.*, double the natural inductance of the line by using relatively small reactances) and $C_1' = 0{\cdot}167$ mfd. per km.

To attain this value of C_1', we must add 0·15 mfd. per km. to the line. This requires a condenser absorbing 4·7 amperes, *i.e.*, 470 K.V.A., so that 700,000 K.V.A. of condensers is required for the complete line. At pre-war costs this would represent an investment of about £700,000 or, say, £4 12s. per KW. delivered, which is not unreasonable considering the result secured.

The use of condensers would make possible also the use of low voltages and cheaper material.

Half-Wave Transmission at 120,000 volts between Lines.—As final example, let us consider the transmission of 150,000 KW. at 50 cycles per second by three 500 sq. mm. aluminium cables for a distance of 315 miles (500 km.), with a phase voltage of 70,000 volts (120 000 volts between lines).

The ratio $\sqrt{(L_1'/C_1')}$ being reduced to 80 by increasing the inductance of the line from 0·0012 to 0·0016 henry per km., and by adding about 0·225 mfd. per km., by condensers taking 4·91 amperes, or 3405 K.V.A. per km., we have the following leading data :—Current delivered 1,020 amperes per phase for 150,000 KW. at $\cos\phi = 0{\cdot}7$; current at the centre of the line 875 amperes at 81,600 volts ; pressure at quarter-point 99,000 volts. Thus the insulation at the danger points on the line has not to provide for more than 100,000 volts above earth potential.

The total condenser capacity required would be 520,000 K.V.A., costing (at pre-war rates) about £3 9s. per KW.

TABLE IX.—Half-Wave Transmission for 315 miles (500 km.) by Three 500-sq. mm. Overhead Aluminium Lines, at 70,000-volts phase-pressure.

Delivered at 70,000 volts.			Input.				Efficiency. %
Power, KW.	Power factor.	Current amps.	Pressure, volts.	Current, amps.	Power factor.	Power, KW.	
150,000	1·0	715	84,200	752	1·0	189,500	79·1
	0·9	794	84,100	831	0·936	196,500	76·3
	0·8	894	84,200	932	0·872	204,500	73·3
	0·7	1,020	84,400	1,038	0·814	217,500	69·0
75,000	1·0	357	78,000	385	1·0	90,100	83·3
	0·9	397	77,800	424	0·926	91,400	82·1
	0·8	447	77,800	474	0·851	94,000	79·8
	0·7	510	77,800	536	0·778	97,100	77·3
37,500	1·0	179	74,800	202	1·0	45,300	82·7
	0·9	198	74,700	221	0·925	47,200	79·4
	0·8	223	74,700	259	0·845	48,900	76·6
	0·7	255	74,700	288	0·766	49,400	75·7
Open circuit	—	—	71,700	19	1·0	4,090	—

Table IX shows the transmission characteristics of such a system. They are quite satisfactory except, perhaps, that the efficiency is rather low owing to the high-current density in the conductors at maximum load (over 2 ampere per sq. mm., or 1,300 ampere per sq. in.) ; larger cables could hardly be used, but 10 per cent. higher efficiency could be secured by using copper lines. The station voltage varies only from 71,700 volts on open circuit to 84,200 volts when delivering 150 000 KW., *i.e.*, less than 18 per cent., notwithstanding the high resistance of the line. This voltage rises steadily with load, and being independent of power factor, it could be provided easily by automatic regulators.

Conclusions.—Artificial half-wave lines, *i.e.*, lines which are given half-wave characteristics by adding reactance coils or condensers, or both, thus make possible efficient transmission of electrical energy for distances of 300 miles or more under acceptable conditions. Up to 10,000 KW. it is sufficient to connect reactances in the line, but for higher power the maximum voltages in the line become dangerously high, and it is necessary to use condensers to increase the line capacity. Up to 50,000 KW. sufficient extra capacity can usually be obtained by merely subdividing the conductors in each phase.

The problem of transmitting electrical energy over distances much greater than those in current practice is technically capable of solution, and without employing material other than that which is already proven in service. Electrical engineers in general owe a debt of gratitude to M. P. Bunet for the pains with which he has developed quantitative examples of the new transmission system.

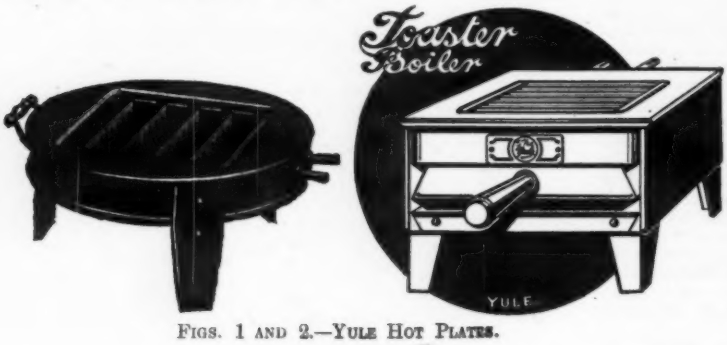
Bank for Trade with Austria.—Reuter's Agency is informed by the Austrian Legation that, with the support of American and Dutch capital, and under the auspices of the Austrian Government, a joint stock company has been formed in Vienna to act as intermediary between foreign capital and Austrian manufacturers. The company especially undertakes the importation of raw material, either directly or by acting as trustee for the foreign capitalist who is sending raw material to Austria to be manufactured there. Special legislation protects the foreign capitalist, who retains his full rights upon the raw material through all the stages of manufacturing the same. The new company, which is called "Treuga," has a nominal capital of 30,000,000 kronen. An interest in the company has already been acquired by Dutch capitalists, and for this purpose a Dutch company, the "Reconstruction Bank for Austria," with a capital of 10,000,000 Dutch florins, has been founded. The "Treuga" is also acting as trustee for the Austrian Government with regard to the credits granted by the Allied Powers and neutral Powers to Austria for buying food and raw material.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

"Yule" Cooking and Heating Devices.

It has been brought to our notice, in connection with the Canadian porcelain-insulated grills that we illustrated in these columns in our August 20th issue, that the Yule Electric Co., of 47, Station Road, Winchmore Hill, London, N. 21, introduced porcelain instead of mica insulation in its griller element some twelve months ago. This element, known as the "Open" type, is used in all the firm's cooking appliances, grillers, figs. 1 and 2, boilers, toasters, and in its small 1-kw. fires. It is of robust construction, the spiral being supported in a number of special perforated porcelain insulators held in parellel position by a framework of pressed steel. The claims that are made for this form of porcelain insulator are: They are not in any way affected by rapid changes of temperature; are a better support for the spiral; and, as they become red hot in a very short time, they make a much more efficient element than when mica is used. The firm has introduced two new specialities in the form of a hot plate and a copper kettle for use on circuits served by 30 to 50-volt country-house lighting plant. The kettle is of the immersion-heater type of an improved design, with a capacity of two pints, and although only having a loading of 300 watts, it has proved a very quick boiler. The low loading is, of course, necessary on account of the limited output of the low-pressure plant in conjunction with which the kettles are intended to be used. The firm also submits special designs for high-class electric fires where they are required in a particular style of ornament or of special dimensions.



Figs. 1 and 2.—Yule Hot Plates.

A Trolley-wire Suspender.

Le Génie Civil describes a device patented in France by N. Antenori for suspending trolley wires, which is illustrated in fig. 3. Usually these clips are of cast metal; the inventor uses stampings of any suitable metal, and prefers to attach the clip to the stem of the insulator with a spherical nut s, which allows the clip to accommodate itself to some extent to the forces in action. A lock-nut d can be used with this device.

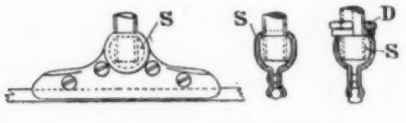


Fig. 3.—Stamped-metal Suspender.

The City Light and Power Plant.

The "City" light and power plant has an extensive range from ¼ to 11 kw., and can be supplied for any voltage—shunt or compound wound according to requirements. The hundred and one household conveniences that electricity offers such as cooking, heating, washing, and vacuum cleaning machines, butter makers, water pumps, &c., can all be installed, and a "City" plant selected that, in capacity and voltage, is best suited to the job. The 2 to 6-kw. sets are fitted with Webber single-cylinder engines as illustrated, fig. 4, and the 7 to 11-kw. sets with the 2-cylinder model of the same engine, which was described on page 776 of our issue of June 18th.

The generators fitted throughout are the well-known ball-bearing K type "City" dynamos. The adaptability of the sets is shown by the fact that any range of power between 3 and 20-h.p. can be obtained at speeds from 500 to 1,100 r.p.m., and this power used direct by means of the crowned pulley fitted on the extension of the engine shaft or from the fly-wheel. This arrangement is of considerable value on farms and country homesteads, where labour-saving machinery is being extensively introduced.

Undoubtedly the foremost requirement of any plant is reliability, and the makers have been at exceptional pains to obtain and prove this feature.

Of importance for lighting purposes is an efficient governor. The type used in this instance is centrifugal, of large size, mounted on one end of the crankshaft and enclosed in the timing-gear cover. The control rods from the governor are carried inside the crankcase where they are protected from damage and freely lubricated. A small spring is provided on the throttle lever by which the speed can be raised or lowered about 20 r.p.m. above or below the normal governed speed. The governor can be set for any desired speed, and will maintain that speed with a variation of less than 3½ per cent. between full load and no-load and without a tendency to hunt. A single governor spring is used which is concentric with the crankshaft so that it is not subjected to centrifugal stresses and, being in compression, there are no attachments to shake loose or break away.

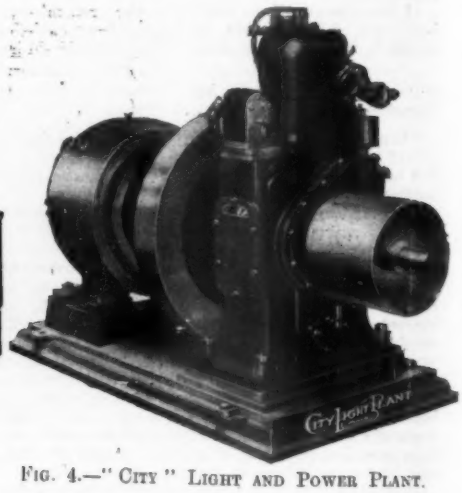


Fig. 4.—"City" Light and Power Plant.

The "City" plant can be supplied as a complete unit assembled on a steel-frame truck arranged for radiator and fan cooling suitable for kinema and other purposes where a portable set is required.

The set is made by the City Electrical Co., Ltd., of 1, Emerald Street, London, W.C. 1.

The "1900 Cataract" Electric Washer.

Yet another electric clothes washer is being placed on the market in this country. This time it is the "1900 Cataract," which is handled by the Electrical Manufacturers' Export Corporation, of New York. The London agents for the device are Messrs. F. J. Shenton & Co., Ltd., of 68, Shoe Lane, E.C. 4, who also deal in lighting and domestic heating apparatus, vacuum cleaners, electrically-driven plate and dish washers, &c. In addition, for the convenience of country

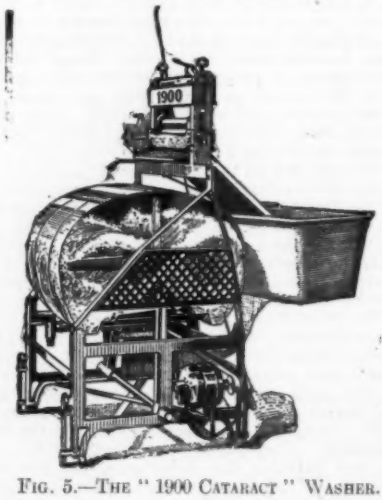


Fig. 5.—The "1900 Cataract" Washer.

residents, selling arrangements have been made with Messrs. Parker, Winan, Achurch, Ltd., Broad Street, Birmingham, and the Municipal Electricity Departments at Stockport, Bradford, and Wolverhampton.

As will be seen from fig. 5, the substantial all-metal frame of the washer is mounted on castors, with four adjustable lifting levers. The solid copper tub has a detachable cover, and is oscillated by means of a spring and lever arrangement. The rocking of the tub is claimed to give a "figure eight" movement to the water and articles being washed, in addition to the scrubbing action, which is obtained by means of the corrugated inverted V shape of the bottom of the tub. Provision is made for oiling all moving parts of the mechanism and cog wheels, a good feature of which is that they are all enclosed. Power is transmitted from the motor mounted on a swinging base, which is under spring tension, by a flat belt. Above the tub a reversible shaft-driven wringer is mounted, which may be adjusted to any position or removed entirely if required. The wringer has a wood frame, white rubber rollers, and is fitted with a quick safety release attachment. The "family" size of machine has a capacity of eight bed sheets at a time, and is driven by a ½-H.P. motor, the dimensions of the wringer rolls being 11 in. by 1¾ in., and the net weight of the machine 272 lb. A larger size is made, which is suitable for laundry purposes.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR JULY, 1920.

The July returns of electrical export business show a reduction of £219,000, as compared with the previous month, due to a decrease in submarine cable exports, these being some £370,000 less than the June total. All other sections of electrical exports, however, show an improvement, the electrical export values for July totalling £1,166,798, as compared with £1,385,974.

The electrical imports for July of £237,498 are slightly in excess of the previous month, the June figures being £219,440.

The re-exports at £13,036 show a small advance on the June total of £12,512.

Values of Electrical Exports and Imports for July, 1920.

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus ...	£185,907	£74,638	£4,688
Insulated wire	386,088	17,247	211
Glow lamps	28,045	5,247	578
Arc lamps and parts	5,885	1,219	—
Batteries	60,351	8,719	—
Meters	34,001	9,769	474
Carbons	16,933	8,967	160
Electrical machinery:—			
Railway and tramway motors ...	2,983	—	—
Other motors and generators ...	114,203	—	—
Electl. machinery (unenumerated)	84,776	95,240	1,949
Switchboards (not teleg. or telep.)	7,656	100	—
Telegraph and telephone cable and apparatus:—			
Wires and cables (not submarine)	86,218	545	1,148
Submarine cables	44,039	—	—
Instruments and apparatus ...	109,713	15,807	8,828
	1,166,798	237,498	13,036

REVIEWS.

Metals in Aircraft Construction. By Wilfred Hanby. Pp. vii+112. London: The Standard Air Press, Ltd. Price 6s. net.

This book is the outcome of a series of lectures given by the author in connection with an aeronautical engineering course at the Aeronautical Institute, and contains the substance of those lectures supplemented by additional matter.

An introduction to the work of the metallurgist is given in Chapter I. This touches on the selecting and handling of metals, advantages of alloy steels, and the scientific heat treatment of metals.

In Chapter II, strength of materials is considered, and particulars are given of the various types of machines used for carrying out impact, hardness, tension, fatigue, and bending tests, and in some cases the results of tests are shown.

Very useful information is given on steel defects, and the best and most satisfactory methods of eliminating piping, blow-holes, roaks, and laps in steel ingots are dealt with in a practical manner. Thermal and mechanical treatment of steel, together with the processes of heating for forging, normalising, annealing, hardening, and tempering take up eight pages, and cover well-known ground. Case-hardening equipment used in heat treatment, control of heat, and treatment temperatures are all dealt with.

Some really useful information is given in Chapter VIII. Here particulars are given of various metals and alloys used in the construction of aircraft and their engines. In the majority of cases, there is indicated not only the composition of the metal or alloy, but also the treatment which it should undergo in order that when a detail or part is made from this metal or alloy, it shall be in the best physical condition to fulfil the requirements of that detail or part in actual practice.

Autogenous welding is dealt with in an up-to-date manner, and useful information is given on fluxes for aluminium, welding cast iron, heat treatment of welds, and fluxes for aluminium alloys.

Although the book is not put forward as covering, either practically or scientifically, the entire field of alloy steels, it can be said to contain a very large amount of really useful information, not only for those specially interested in aircraft, but also for the general engineer who wishes to obtain helpful practical knowledge of the testing and treatment of metals and alloys.

The book is well printed, and published at a very reasonable price in these days. E. P.

Radio Engineering Principles. By Henri Lauer and Harry L. Brown. 300 pages, 241 figs. London: Hill Publishing Co., Ltd. Price 21s. net.

In the words of Major-General G. O. Squier, this book "covers fully and clearly, without too great use of mathematics, the theory involved in the wonderful developments in radio-communication during the war, except for certain reservations which it is not possible to release at present." The book thus belongs to a class which we are glad to find becoming more numerous, viz., that of books written for specialist students and for men in practice with a minimum of repetition of fundamental matters which, having once been well established, should not be repeated indefinitely in every book dealing with subjects involving these fundamentals. This book embodies new matter to an unusual degree, being largely devoted to the characteristics and use of the three-electrode vacuum tube in wireless telegraphy and telephony. There is, however, a valuable preliminary treatment of the principles involved by older radio-apparatus, this treatment occupying about half the volume, and giving the student a sound exposition of underlying electrical theory, the properties of oscillatory circuits, aerial systems and radiation, and damped and undamped wave radio-telegraphy. Throughout the book the description of specific apparatus is purposely avoided in order that as detailed treatment as possible may be given to the principles of radio-communication and to the general means of utilising these principles in practical work.

Mechanical analogies are avoided in developing the principles of radio work, and this is a good feature, the assistance derived from such analogies being very problematical. The authors state definitely that the earnest student of radio-engineering must have a general knowledge of the electron theory of matter and of the interpretation in terms of that theory of the phenomena of electric conduction and induction. It is assumed that the reader is familiar with the usual electrical phenomena, and those of special importance in radio work are reviewed from the standpoint of the electron theory. This being accomplished, the properties of oscillatory circuits are dealt with in Chapter II, special attention being, of course, paid to coupling and resonance. The mathematics introduced is as simple and as small in amount as possible, but the treatment provides for the definite quantitative analysis of circuits. This is a matter which has received too little attention from many earlier writers on wireless subjects, and even in this volume we should like to have a chapter devoted specifically to the quantities affecting radiation and transmission, giving the simplest possible equations, and illustrating by numerical examples the relative importance of the different variables and the calculation of sending and receiving currents, &c. Such a chapter seems to come distinctly within the scope of the book.

Dealing with antenna systems and radiation, the authors consider closed and open oscillators, and give a very clear conception of the phenomena of wave propagation. Antenna constants and types are discussed rather more briefly than is desirable, and it is questionable whether a book devoted specifically to radio-engineering principles ought to rest content with the statement that it is "rather difficult to calculate accurately the constants of an antenna from its dimensions because of numerous variable factors, &c." There is surely a happy medium between an over-abundance of mathematics and a mere reference to a Bureau of Standards circular, where such a vital matter is concerned? Similarly the factors affecting transmission range deserve more detailed treatment than is here given, and it would be an excellent thing if the authors could give any convincing experimental data regarding the actual directional effect of various aerials at considerable distances. A very clear exposition is given of the conduction theory of radio-communication.

Chapters IV and V give a lucid explanation of the characteristics and relative merits of damped and undamped wave systems and of the various circuits employed for receiving. Little more than the bare outlines are given concerning the high-frequency alternator and arc systems, both of which underwent considerable development during the war. The prospects of the high-frequency arc system are by no means so slender as might be deduced from the paucity of literature

describing its achievements; the recent article in this journal describing the Elwell equipment was a timely reminder that there are more ways than one of effecting wireless communication round the world. The authors make the best use of the small space which they devote to the alternator and arc systems, and it is to be hoped that they will give a more detailed treatment in subsequent editions.

The general properties and certain constants of the three-electrode vacuum tube are discussed in Chapter VI, and its use as detector, amplifier, oscillator and modulator are taken up in the succeeding chapters in detail proportionate to the enormous importance of these tubes in present day radio work. It is in connection with the vacuum tube that the book reaches its greatest value, but, as the authors point out in their preface, not all of the developments during the war, nor indeed the most wonderful of them, are published "because of the wishes of the military authorities to keep them secret." Probably such an attitude is defensible, conditions being as they are, but it is deplorable from the standpoint of the student and it contrasts ironically with the dedication of the book which is "to the advancement of mankind in peace"!

In the chapters dealing with the vacuum tube, the authors present a number of characteristic curves, and deal adequately with the mathematical theory and physical interpretation of the characteristics of the tube in its various applications. Here, as throughout the volume, the line illustrations are beyond reproach, but the photographic reproductions are not particularly clear. This, however, is a minor point, the main aim (viz., explanation of the characteristics and applications of the vacuum tube) being well accomplished. The reasons for various constructions are made clear, and the circuits and adjustments in various applications are discussed fully.

The chapter on radio-telephony is probably the best treatment yet provided concerning the principles and circuits employed. To the reader with imagination the facts recounted represent extraordinary developments, but the authors do not, of course, indulge in any sensationalism. The same remarks apply to the final chapters on directional radio and loop antennæ, radio-goniometry, and miscellaneous applications of radio circuits in aeroplanes, submarines and other circuits. The authors are to be complimented upon an able treatment of the latest radio principles and applications, which treatment may be expanded in later editions, but is certainly open to no destructive criticism.

Electrical Ignition. By M. A. Codd. Pp. vii+164; 120 figs. London: E. & F. N. Spon. 6s. net.

This hand-book on ignition for internal combustion engines contains such a wealth of practical detail, and shows so wide and general a knowledge of actual structures and their care and repair that it seems ungracious to offer any adverse criticism. While we note the modesty of the author's claims as to definitions, &c., in the Introduction, we feel bound to express regret that the confusion between quantity and rate of flow which troubles the very "lay mind" for which the book is written should be perpetuated on pages 1 and 93. Again, the distinction between E.M.F. of accumulators and the far more vital P.D. under load is marked by a suggestion that high resistance voltmeters are actually *inferior* for testing cells.

The layman scarcely ever realises that the lower limit of 1.8 should be measured with a voltmeter of the highest resistance possible, under normal conditions of load on the cell. There are other little points of theory which we think might have been more carefully dealt with, but we prefer to lay emphasis on the real excellence of the greater part of the book. There is scarcely a practical system or appliance of importance that is not described fully, and the chapters on faults, remedies, and repairs are exactly what the average motorist requires.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

23,859. "Devices for regulating amplitudes and damping in sound apparatus." Signal Ges. August 16th. (Germany, August 18th, 1919.)

23,860. "Frequency filters." British Thomson-Houston Co., F. W. Carter and R. C. Clinker. August 16th.

23,861. "Radio-receiving systems." British Thomson-Houston Co. (General Electric Co.). August 16th.

23,863. "Variable electrical condensers." J. Joseph and H. W. Sullivan. August 16th.

23,899. "Telephone, &c., circuits." Western Electric Co. (Western Electric Co.). August 16th.

23,906. "Permanent magnets for electric machines." D. J. Pickee. August 16th. (Germany, August 16th, 1919.)

23,909. "Reversing direction of rotation of direct-current dynamo-electric machines." R. Bosch Akt. Ges. August 16th. (Germany, August 16th, 1919.)

23,938. "Electric motors." Hoover Suction Sweeper Co. (H. E. Hoover). August 17th.

23,961. "Thermionic valves, &c." H. L. Crowther and W. Makower. August 17th.

23,964. "Radio-receiving systems." British Thomson-Houston Co. (General Electric Co.). August 17th.

23,965. "Electric switches." British Thomson-Houston Co. (General Electric Co.). August 17th.

23,977. "Ceiling-roses, cut-outs, connectors, &c." H. B. Prentice. August 17th.

23,978. "Electric switches." H. B. Prentice. August 17th.

23,979. "Electric distribution of fuse boards, &c." H. B. Prentice. August 17th.

24,011. "Electrical transmission systems." A. M. Taylor. August 18th.

24,018. "Filament electric lamps." A. G. France. August 18th.

24,024. "Process of manufacturing insulators." P. J. H. Bernard. August 18th.

24,029. "Sparking plugs." W. A. Clark and Sphinx Manufacturing Co. August 18th.

24,043. "Electrical oscillatory circuits." W. J. Lyons and Selective Signal Co. August 18th.

24,046. "Current-collecting trolley." J. Jassaud. August 18th. (France, August 21st, 1919.)

24,054. "Signalling systems." Western Electric Co. August 18th. (United States, October 31st, 1919.)

24,058. "Devices for supplying and/or controlling electricity." A. R. Angus. August 19th.

24,059. "Electric generators." H. J. Warner. August 18th.

24,064. "Machine for making lamp bulbs, &c." British Thomson-Houston Co. (General Electric Co.). August 18th.

24,077. "Lighting machines for cycles, motor-cars, &c." R. Bosch Akt. Ges. August 18th. (Germany, September 22nd, 1919.)

24,112. "Sparking plugs." E. A. Albrigt. August 19th.

24,163. "Electrically-heated hair-waving appliances." A. M. Taddei. August 19th.

24,166. "Electrolytic rectifiers." R. W. McClintock and D. McKinnon. August 19th.

24,198. "Three-phase electric furnaces." D. Mauri. August 19th.

24,210. "Electrolysis of acetone solutions." E. F. Morris. August 20th.

24,241. "Electric switches." G. H. Brader. August 20th.

24,243. "Means of cooling electrodes." W. E. John. August 20th.

24,253. "Electrical circuit-breakers." W. B. Ensign and H. E. Wadsworth. August 20th.

24,262. "Electric motor-control." British Thomson-Houston Co. (General Electric Co.). August 20th.

24,263. "Vibration apparatus for reception and production of sound waves." Signal Ges. August 20th. (Germany, August 21st, 1919.)

24,275. "Regulating resistances." Akt. Ges. Brown, Boveri et Cie. August 20th. (Switzerland, August 26th, 1919.)

24,278. "Electrical transformers." British Electric Transformer Co. and J. Roothaan. August 20th.

24,296. "Electrical heater." H. Lipke. August 20th.

24,311. "Electric switches." F. Zuckschwerdt. August 20th.

24,314. "Galvanic batteries." G. Oldham, J. Oldham, O. Oldham and Oldham & Son. August 20th.

24,320. "Electric batteries." A. C. Brown. August 21st.

24,338. "Fuse-holders for electric car-lighting systems." C. A. Miller, F. J. Miller, and E. A. Saunders. August 21st.

24,339. "Circuit arrangements for controlling automatic selector switches." Automatic Telephone Manufacturing Co. and R. Mercer. August 21st.

24,356. "Electric service lifts." E. R. Elliston. August 20th.

24,360. "Electric cut-out and theft preventing devices for motor vehicles." F. W. Andrews and W. J. Brough. August 21st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

10,280. "Ionic relays." W. H. Eccles and F. W. Jordan. June 21st, 1918. (148,582.)

1919.

2,243. "Signalling apparatus." S. Oulianine. January 29th, 1919. (148,586.)

2,584. "Methods and apparatus for submarine signalling and detection." R. A. Fessenden. February 1st, 1918. (148,589.)

7,624. "Magneto-electric generators." S. G. Brown. March 20th, 1919. (148,600.)

7,737. "Wooden stakes, posts, poles and the like for electrical and other purposes." H. Nobs. March 27th, 1918. (125,068.)

9,586. "Electro-mechanical propulsion and control of submersible vessels." N. H. Wood. April 15th, 1919. (148,605.)

10,532. "Transmitters for telephony." H. J. Round. April 28th, 1919. (Cognate application 26,374/19.) (148,632.)

10,857. "Electrodes for use in electric welding." A. C. Hyde. May 1st, 1919. (148,646.)

11,192. "Electrical resistance controls for vehicles." Tilling-Stevens, Ltd., and A. H. Silcock. May 5th, 1919. (148,651.)

11,916. "Controlling means for controlling a series of electric motors." F. G. Warburton. May 12th, 1919. (148,655.)

12,254. "Electrical precipitation of particles from gases." D. K. Morris and F. H. Haviland. May 15th, 1919. (148,659.)

13,023. "Manufacture of electric cables containing conductors conveying currents in parallel." Johnson & Phillips and D. A. S. Porteous. May 23rd, 1919. (148,667.)

16,228. "Electric transformers." H. L. Crowther. June 27th, 1919. (148,679.)

16,982. "Device for measuring electrical resistance." C. E. Foster. July 7th, 1919. (148,686.)

18,517. "Electric reactance coils or transformers." Electrical Improvements, Ltd., and J. R. Beard. July 25th, 1919. (148,691.)

18,896. "Electric heating devices and methods of making the same." British Thomson-Houston Co. (General Electric Co.). July 30th, 1919. (148,693.)

19,300. "Magneto-electric generators for use in connection with internal-combustion engines." G. P. Godfree. August 5th, 1919. (148,695.)

21,327. "Electric lamp holders, fitments, and the like." W. Preston. August 30th, 1919. (148,709.)

23,623. "Electro-magnetically-operated vibrators." W. J. Mellersh-Jackson. (Submarine Signal Co.). September 25th, 1919. (148,703.)

25,100. "Machine switching telephone exchange systems." Western Electric Co. and L. Polinkowsky. (May 1st, 1918.) (Divided application on 7,309/18.) (148,708.)

27,226. "Portable electric lamps." J. Tweedie. November 5th, 1919. (148,712.)

1920.

4,470. "Terminal connections for electric conductors." O. Imray (R. Bosch Akt. Ges.) February 13th, 1920. (148,725.)

11,771. "Method of making spark-plug insulators." A. E. Alexander (General Ceramics Co.). April 28th, 1920. (148,731.)